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CONTENTS OF No. 13.

	PAGE
Hyacinth Bulbs. By Grant Allen	261
Brain Troubles: Partial Loss of Speech	262
Dr. J. W. Draper. By the Editor. (*With a Portrait.*)	263
The Great Pyramid. By the Editor (*Illustrated*)	265
The True Story of the Moon	268
Babylonian Discoveries. By a Member of the Society of Biblical Archæology	268
Intelligence of the House Martin. By Henry J. Slack	269
Intelligence in Animals	269
Ghosts. By Andrew Wilson	269
Artificial Indigo	270
Science and Religion	271
CORRESPONDENCE:—Chinese Calculation—Mind *v.* Doctors—Sea Serpent or Seaweed?—Marine Boilers—Intelligence in Animals—Electrical Images—Mortality from Cancer—Arranged Squares, &c.	272-278
Queries	278
Replies to Queries	279
Answers to Correspondents	280
Notes on Art and Science	281
Our Mathematical Column	282
Our Chess Column	282
Our Whist Column	284

HYACINTH BULBS.

BY GRANT ALLEN.

IF we were not so familiar with the fact, we would think there were few queerer things in nature than the mode of growth followed by this sprouting hyacinth bulb on my mantelpiece here. It is simply stuck in a glass stand, filled with water, and there, with little aid from light or sunshine, it goes through its whole development like a piece of organic clockwork, as it is, running down slowly in its own appointed course. For a bulb does not grow as an ordinary plant grows, solely by means of carbon derived from the air under the influence of sunlight. What we call its growth we ought rather to call its unfolding. It contains within itself everything that is necessary for its own vital processes. Even if I were to cover it up entirely, or put it in a warm, dark room, it would sprout and unfold itself in exactly the same way as it does here in the diffused light of my study. The leaves, it is true, would be blanched and almost colourless, but the flowers would be just as brilliantly blue as these which are now scenting the whole room with their delicious fragrance. The question is, then, how can the hyacinth thus live and grow without the apparent aid of sunlight, on which all vegetation is ultimately based?

Of course, an ordinary plant, as everybody knows, derives all its energy or motive-power from the sun. The green leaf is the organ upon which the rays act. In its cells the waves of light propagated from the sun fall upon the carbonic acid which the leaves drink in from the air, and by their disintegrating power, liberate the oxygen while setting free the carbon, to form the fuel and food-stuff of the plant. Side by side with this operation the plant performs another, by building up the carbon thus obtained into new combinations with the hydrogen obtained from its watery sap. From these two elements the chief constituents of the vegetable tissues are made up. Now the fact that they have been freed from the oxygen with which they are generally combined gives them energy, as the physicists call it, and, when they re-combine with oxygen, this energy is again given out as heat, or motion. In burning a piece of wood or a lump of coal, we are simply causing the oxygen to re-combine with these energetic vegetable substances, and the result is that we get once more the carbonic acid and water with which we started. But we all know that such burning yields not only heat, but also visible motion. This motion is clearly seen even in the draught of an ordinary chimney, and may be much more distinctly recognised in such a machine as the steam-engine.

At first sight, all this seems to have very little connection with hyacinth bulbs. Yet, if we look a little deeper into the question, we shall see that a bulb and an engine have really a great many points in common. Let us glance first at a somewhat simpler case, that of a seed, such as a pea or a grain of wheat. Here we have a little sack of starches and albumen laid up as nutriment for a sprouting plantlet. These rich food stuffs were elaborated in the leaves of the parent pea, or in the tall haulms of the growing corn. They were carried by the sap into the ripening fruit, and there, through one of those bits of vital mechanism which we do not yet completely understand, they were selected and laid by in the young seed. When the pea or the grain of wheat begins to germinate, under the influence of warmth and moisture, a very slow combustion really takes place. Oxygen from the air combines gradually with the food stuffs or fuels—call them which you will—contained in the seed. Thus heat is evolved, which in some cases can be easily measured with the thermometer, and felt by the naked hand—as, for example, in the malting of barley. At the same time motion is produced; and this motion, taking place in certain regular directions, results in what we call the growth of a young plant. In different seeds this growth takes different forms, but in all alike the central mechanical principle is the same:—certain cells are raised visibly above the surface of the earth, and the motive power which so raised them is the energy set free by the combination of oxygen with their starches and albumens. Of course, here, too, carbonic acid and water are the final products of the slow combustion. The whole process is closely akin to the hatching of an egg into a living chicken. But, as soon as the young plant has used up all the material laid by for it by its mother, it is compelled to feed itself just as much as the chicken when it emerges from the shell. The plant does this by unfolding its leaves to the sunlight, and so begins to assimilate fresh compounds of hydrogen and carbon on its own account.

Now it makes a great deal of difference to a sprouting seed whether it is well or ill provided with such stored-up food-stuffs. Some very small seeds have hardly any provisions to go on upon; and the seedlings of these, of course, must wither up and die if they do not catch the sunlight as soon as they have first unfolded their tiny leaflets; but other wiser plants have learnt by experience to lay by plenty of starches, oils, or other useful materials in their seeds; and wherever such a tendency has once faintly appeared, it has given such an advantage to the species where it occurred, that it has been increased and developed from generation to generation through natural selection. Now what such plants do for their offspring, the hyacinth, and many others like it, do for themselves. The lily family, at least in the temperate regions, seldom grows into a tree-like form; but many of them have acquired a habit which enables them to live on almost as well as trees from season to season, though their leaves die down completely with each recurring winter. If you cut open a hyacinth bulb, or, what is simpler to experiment upon, an onion, you will find that it consists of several short abortive leaves, or thick fleshy scales. In these sub-

terranean leaves the plant stores up the food-stuffs elaborated by its green portions during the summer; and there they lie the whole winter through, ready to send up a flowering stem early in the succeeding spring. The material in the old bulb is used in thus producing leaves and blossoms at the beginning of the second or third season; but fresh bulbs grow out anew from its side, and in these the plant once more stores up fresh material for the succeeding year's growth.

The hyacinths which we keep in glasses on our mantelpieces represent such a reserve of three or four years' accumulation. They have purposely been prevented from flowering, in order to make them produce finer trusses of bloom when they are at length permitted to follow their own free will. Thus the bulb contains material enough to send up leaves and blossoms from its own resources; and it will do so even if grown entirely in the dark. In that case the leaves will be pale yellow or faintly greenish, because the true green pigment, which is the active agent of digestion, can only be produced under the influence of light; whereas the flowers will retain their proper colour, because their pigment is always due to oxidation alone, and is but little dependent upon the rays of sunshine. Even if grown in an ordinary room, away from the window, the leaves seldom assume their proper deep tone of full green; they are mainly dependent on the food-stuffs laid by in the bulb, and do but little active work on their own account. After the hyacinth has flowered, the bulb is reduced to an empty and flaccid mass of watery brown scales.

Among all the lily kind, such devices for storing up useful material, either in bulbs or in the very similar organs known as corms, are extremely common. As a consequence, many of them produce unusually large and showy flowers. Even among our native English lilies we can boast of such beautiful blossoms as the fritillary, the wild hyacinth, the meadow-saffron, and the two pretty squills; while in our gardens the tiger lilies, tulips, tuberoses, and many others belong to the same handsome bulbous group. Closely-allied families give us the bulb-bearing narcissus, daffodil, snowdrop, amaryllis, and Guernsey lily; the crocus, gladiolus, iris, and corn-flag; while the neighbouring tribe of orchids, most of which have tubers, probably produce more ornamental flowers than any other family of plants in the whole world. Among a widely-different group we get other herbs which lay by rich stores of starch, or similar nutritious substances, in thickened underground branches, known as tubers; such, for example, are the potato and the Jerusalem artichoke. Sometimes the root itself is the storehouse for the accumulated food-stuffs, as in the dahlia, the carrot, the radish, and the turnip. In all these cases, the plant obviously derives benefit from the habit which it has acquired of hiding away its reserve fund beneath the ground, where it is much less likely to be discovered and eaten by its animal foes. For it is obvious that these special reservoirs of energetic material, which the plant intends as food for its own flower or for its future offspring, are exactly those parts which animals will be likely unfairly to appropriate to their personal use. What feeds a plant will feed a squirrel, a mouse, a pig, or a man, just as well. Each requires just the same free elements, whose combination with oxygen may yield it heat and movement. Thus it happens that the parts of plants which we human beings mainly use as food-stuffs are just the organs where starch has been laid by for the plant's own domestic economy—seeds, as in the pea, bean, wheat, maise, barley, rice, or millet; tubers, as in the potato and Jerusalem artichoke; corns, as in the yam or tare; and roots, as in arrowroot, turnip, parsnip and carrot. In all these, and in many other cases, the habit first set up by nature has been sedulously encouraged and increased by man's deliberate selection. What man thus consciously effects in a few generations, the survival of the fittest has unconsciously effected through many long previous ages of native development.

BRAIN TROUBLES.

Partial Loss of Speech.

LET us consider next a case where the almost complete loss of the power of fixing the attention was followed by the partial loss of the power of expression,—a sequence which would, we believe, be far more commonly noticed than usual were all the circumstances of each case carefully noted. The case also illustrates the danger resulting from the endeavour to over-tax the powers of nature:—"I was engaged this morning," says Dr. Alexander Crichton, "with a great number of people, who followed each other quickly, and to each of whom I was obliged to give my attention. I was also under the necessity of writing much, but the subjects were various, and of a trivial and uninteresting nature, and had no connection the one with the other; my attention, therefore, was constantly kept on the stretch, and it was continually shifting from one subject to another. At last it became necessary that I should write a receipt for some money I had received on account of the poor. I seated myself, and wrote the two first words, but in a moment found that I was incapable of proceeding, for I could not recollect the words which belonged to the ideas that were present in my mind. I strained my attention as much as possible, and tried to write one letter slowly after the other, always having an eye in order to observe whether they had the usual relationship to each other; but I remarked, and said to myself at the time, that the characters I was writing were not those which I wished to write, and yet I could not discover where the fault lay. I therefore desisted, and partly by words and syllables, and partly by gestures, I made the person who waited for the receipt understand that he should leave me. For about half-an-hour there reigned a kind of tumultuous disorder of my senses, in which I was incapable of remarking anything very particular, except that one series of ideas forced themselves involuntarily into my mind." The patient goes on to describe the various thoughts which occurred to him at this time, and how he tested his mental condition by thinking of the principles of religion, conscience, and the future life, finding to his relief that these principles he found "equally correct and fixed as before" (a degree of assurance which some do not possess who are quite free from mental disorder). Passing over these matters, as not bearing specially on our subject, we find that so soon as he tested his power of expressing his ideas, either by spoken or by written words, he found that for the time being the power was lost. "I endeavoured to speak, in order to discover whether I was capable of saying anything that was connected; but, although I made the greatest efforts of attention, and proceeded with the utmost caution, I perceived that I uniformly spoke other words than I intended. My soul was at present as little master of the organs of speech as it had been before of my hand in writing. Thank God, this state did not continue very long, for in about half-an-hour my head began to grow clearer, the strange and tiresome ideas became less vivid and turbulent, and I could command my own thoughts with less interruption." It is interesting to notice how the loss of the power of expression was associated thus with con-

fusion of thought and inability to fix the attention. "I now wished," proceeds the patient, "to ring for my servant, and desired him to inform my wife to come to me." (The power of correctly expressing his ideas does not seem to have been possessed in any very remarkable degree by this gentleman, even when his mind had fully recovered its usual health). "But I found it still necessary to wait a little longer, to exercise myself in the right pronunciation of the few words I had to say, and the first half-hour's conversation I had with her was, on my part, preserved with a slow and anxious circumspection, until at last I gradually found myself as clear and serene as in the beginning of the day. All that now remained was a slight headache. I recollected the receipt I had begun to write, and in which I knew I had blundered, and upon examining it, I observed, to my great astonishment, that instead of the words *fifty dollars, being one half-year's rate*, which I ought to have written, the words were, *fifty dollars, through the salvation of Bra*——, with a break after it, for the word '*Bra*' was at the end of the line. I cannot recollect any business I had to transact that could by means of an obscure influence have produced this phenomenon."

In this case it is obvious that the temporary loss of the power of verbal expression was occasioned by overwork; but it is noteworthy that the work was of a special character, involving the special exercise of the power which failed first (that of fixing the attention). It may be worth while to inquire whether that kind of mental confusion, which, when it has passed beyond a certain point is followed by impairment of the power of speech, is generally or often a consequence of distracting occupations. The following case seems to some degree to bear on this question. It is related by Dr. Watson. A patient who had had an attack of apoplexy seemed to be recovering under the influence of perfect quiet. But, "after a long and imprudent conversation with a friend, he suddenly lost the thread of his discourse, and could not recover it." Memory was affected first, be it observed: next went the power of attention. "Then he became confused." Thirdly, the power of speech was affected. "He misapplied words. I asked him how he felt. He answered, 'Not quite right,' and this he repeated very many times, abbreviating it at first into 'not right,' and and at length into 'n' ight.' Wishing to mention '*camphor*,' he called it '*pamphlet*.' I mention these as specimens." Afterwards, signs of bodily weakness, indicating paralysis, were observed. The weakness degenerated gradually into complete palsy, and before long the case ended fatally. In this case the patient had not suffered originally from undue mental work, the mental trouble being caused by an abscess. But the case seems to illustrate well the trying effect of distracting conversation on a wearied, weakened, or (as in this case) diseased brain.

The tendency to use one word for another, where, so far as meaning is concerned, there is no connection whatever, though there is some resemblance of sound, is one which probably most literary men have noticed at times, when they have been wearied or their attention has been much distracted. It is not by any means so alarming a symptom as temporary failure of the power of articulating words, or actual inability to write the desired words; but it is a circumstance which should not be overlooked. A little rest, or the substitution for awhile of some light reading for hard brain-work, will generally set matters right. If not, a longer rest or open-air exercise should be taken. Time will be gained by waiting till the brain is fitter for work. The present writer has repeatedly had occasion to time himself over certain forms of literary work, and his experience has been this, that where four or five hours are to be occupied in steady work, a good half-hour will often be saved by taking half-an-hour's sleep, when such signs of mental weariness are noticed as have been described above. There is, however, one point to be observed. Rest must be taken as soon as such signs are recognised, for if an effort is made to struggle against the occasion for rest, the power of resting may be lost. Precisely as an over-tired pedestrian often tries in vain to sleep, when he has but a short time for rest, so the overwearied brain may be kept by confusing thoughts from obtaining rest.

DR. J. W. DRAPER.

BY THE EDITOR. (*With a Portrait.*)

AMONG the distinguished men whose acquaintance I have made during my lecture tours in this country America, and Australasia, few occupy a higher place in my recollection than Dr. J. W. Draper, whose death, at New York, has just been announced. His scientific researches and literary work are justly regarded by those whom we must consider as his fellow-countrymen (though he was an Englishman by birth) as most important and valuable, and his name is not honoured in America only, but throughout the world.

John William Draper was born at St. Helen's, near Liverpool, in 1811, and educated there and at the London University (to which he was sent to study chemistry when the University was first opened). He left England soon after for America, and completed his medical education at the University of Pennsylvania, graduating in 1836. He was soon after appointed Professor of Chemistry in Hampden Sydney College, Virginia, and in 1839 in the University of New York.

His earliest contributions to Science were on the chemical action of light, on which he published nearly forty memoirs. The following summary of his work on this subject is from a biographical sketch which appeared in the *Popular Science Monthly*, in January, 1874 (about the time when I first made Dr. Draper's acquaintance). I believe that though they may have been editorially revised by my esteemed friend Professor Youmans, they were in substance communicated by Dr. Draper himself, thus possessing a special value at the present time, when some of his most important researches are bearing fruit, which others are claiming as their own:—

"Of all the chemical actions of light, by far the most important is that of the decomposition of carbonic acid by the leaves of plants, under the influence of sunshine. On this the whole vegetable world depends for its growth, and the whole animal world, directly or indirectly, for its food. The decomposition in question is essentially a deoxidation, and up to about 1840 it was generally supposed to be due to the violet rays of the spectrum, which, in accordance with the views held at that time, were regarded as producing deoxidising actions, and were consequently known as deoxidising rays. But this was altogether an assumption unsupported by experimental proof. Professor Draper saw that there was but one method for the absolute solution of the problem, and that was by causing the decomposition to take place in the spectrum itself. In this delicate and beautiful experiment he succeeded, and found that the decomposition was brought about by the yellow rays, at a maximum by those in the vicinity of the Fraunhofer fixed line D, and that the violet rays might be considered as altogether inoperative. The memoir containing this result was first read before the American Philosophical Society, in Philadelphia, and immediately republished in London, Paris, and Berlin. It excited general interest among

chemists. Even so late as 1874 it furnished to the German experimenters the basis of a very interesting discussion in photo-chemistry.

"In 1842 Dr. Draper discovered that not only might the Fraunhofer fixed lines in the spectrum be photographed, but that there exists a vast number of others beyond the violet, which up to that time had been unknown. He also found three great lines less refrangible than the red, in a region altogether invisible to the eye. Of these new lines, which more than doubled in number those of Fraunhofer, he published engravings. He also

DR. J. W. DRAPER.

invented an instrument for measuring the chemical force of light—the chlor-hydrogen photometer. This was subsequently extensively used by Bunsen and Roscoe in their photo-chemical researches. In their paper, read before the Royal Society in 1856, they say, 'With this instrument Draper succeeded in establishing experimentally some of the most important relations of the chemical action of light.'

"His memoir 'On the Production of Light by Heat,' published in 1847, was an important contribution to spectrum analysis. Among other things it gave the means for determining the solid or gaseous condition of the sun, the stars, and the nebulæ. In this paper he established experimentally that all solid substances, and probably liquids, become incandescent at the same temperature; that the thermometric point at which such substances are red-hot is about 977° Fahr.; that the spectrum of an incandescent solid is continuous, it contains neither bright nor dark fixed lines; and from common temperatures up to 977° Fahr. the rays emitted by a solid are invisible, but at that temperature they impress the eye with the sensation of red; that the heat of the incandescing body being made continuously to rise, other rays are added, increasing in refrangibility as the temperature ascends; and that, while the addition of rays so much the more refrangible as the temperature is higher is taking place, there is an augmentation in the intensity of those already existing. This memoir was published in both American and European journals. An analysis of it was read in Italian before the Royal Academy at Naples, July, 1847, by Melloni, which was also translated into French and English. But, thirteen years subsequently, M. Kirchhoff published, in a very celebrated memoir, considered by many as the origin of spectrum analysis, and of which an English translation may be

found in the *London and Edinburgh Philosophical Magazine*, July, 1860, the same facts under the guise of mathematical deductions, with so meagre a reference to what Draper had done, that he secured the entire credit of these discoveries. In an historical sketch of spectrum analysis, subsequently published, Kirchhoff avoided all mention of his American predecessor.

"Dr. Draper was the first person who succeeded in taking portraits of the human face by photography. This was in 1839. He published a minute account of the process at a time when in Europe it was regarded as altogether impracticable. He also was the first to take photographs of the moon, and presented specimens of them to the New York Lyceum of Natural History, in 1840.

"'A Treatise on Human Physiology, Statical and Dynamical,' became a standard text-book in American colleges. It has passed through a great many editions, and was translated into several foreign languages. The Russian edition is used in the higher schools of that country. A yet more important work is his 'A History of the Intellectual Development of Europe,' thus described in the *Westminster Review*:—'It is one of the not least remarkable achievements in the progress of positive philosophy that have yet been made in the English tongue: a noble and even magnificent attempt to frame an induction from all the recorded phenomena of European, Asiatic, and North-African history.'" [Of this treatise, Dr. Draper's later work, "The Conflict of Science and Religion," may be regarded as in some sense an abstract. It is severe in its treatment of religious intolerance and dogmatism, and does not seem to do full justice to the motives which in many cases have actuated religious persecutions. But the book is the product of a healthy and vigorous mind, and, setting aside the undue hardness of its tone in certain places, it must be regarded as a work which has done, and is calculated to do, an immense deal of good.]

"Though in his earlier years Dr. Draper was a skilful mathematical analyst, he has published but few mathematical papers, the most important being an investigation of the electrical conducting power of wires. This was undertaken at the request of Prof. Morse, at the time he was inventing his telegraph. The use made by Morse of this investigation is related by him in 'Silliman's American Journal of Science and Arts,' December, 1843. The paper shows that an electrical current may be transmitted through a wire, no matter what the length may be, and that, generally, the conducting effect of wires may be represented by a logarithmic curve. Among electrical memoirs there is one on the tidal motions exhibited by liquid conductors, and one on the electro-motive power of heat, explaining the construction of some new and improved forms of thermo-electric batteries. An abstract of these improvements is given in the last edition of the 'Encyclopædia Britannica' (Art. Voltaic Electricity).

"Dr. Draper was the first person to obtain photographs of the diffraction spectrum given by a grating, and to show the singular advantages which that spectrum possesses over the prismatic investigations on radiations. In a memoir on the production of light by chemical action (1848), he gave the spectrum analyses of many different flames, and devised the arrangement of charts of their fixed lines in the manner now universally adopted. A memoir on phosphorescence contains the experimental determination of many important facts in relation to that property. Among purely chemical topics he has furnished a method for the qualitative determination of urea by nitrous acid."

[From 1860 to 1870 Dr. Draper did but little in scientific research, devoting himself mostly to historical works. During this time he published his "History of the American Civil War," in three volumes.]

"In the summer of 1870, Dr. Draper suffered a severe bereavement in the loss of his wife. Of Brazilian birth, she was connected with an ancient and noble Portuguese family. She had rendered his domestic life a course of unbroken happiness, and doubtless she was the exemplar before his eyes when he wrote that oft-quoted passage in his Physiology,' in which, after depicting the physical and intellectual peculiarities of woman, he says: 'But it is in the family and social relations that her beautiful qualities shine forth. At the close of a long life, checkered with pleasures and misfortunes, how often does the aged man with emotion confess that, though all the ephemeral acquaintances and attachments of his career have ended in disappointment and alienation, the wife of his youth is still his friend? In a world from which everything else seems to be passing away, her affection alone is unchanged; true to him in sickness as in health, in adversity as in prosperity, true to the hour of death.'"

Of their six children, one died in infancy; the survivors are three sons and two daughters. Of the former, the eldest, Dr. Henry Draper, Professor of Natural History in the College of the City of New York, is eminent as a physicist and astronomer; the second, Dr. John C. Draper, is Professor of Physiology in the University of New York; the third, Dr. Daniel Draper, is Director of the Meteorological Observatory in the New York Central Park, where he has exercised an important influence in developing the meteorological system of the United States. In recent years, Dr. Draper has published two short memoirs: one, on the "Distribution of Heat in the Spectrum," showing that the predominance of heat in the less refrangible regions is due to the action of the prism, and would not be observed in a normal spectrum, such as is formed by a grating; and that all the rays of light have intrinsically equal heating power; the second an investigation of the distribution of chemical force in the spectrum. The *Popular Science Monthly* notes to his credit that "these scientific researches, to which so many years of his life have been devoted, *have been at his own expense; he has never received any extraneous aid, though many of them have been very costly; he has never taken out any patent, but has given the fruits of his investigations and inventions freely to the public.*"

THE GREAT PYRAMID.

BY THE EDITOR.

IN No. 10 we showed how the builders of the Great Pyramid, in carrying out what obviously was their purpose, the exact orientation of the building, would have been led to construct those passages, descending and ascending, which actually exist in the building, with precisely the slopes we should expect to find; but we did not pass beyond the smaller of the ascending passages; and, indeed, it is to be noticed that in passing upwards from the upper end of this passage we recognise another plan. All the features thus far have been such as we should expect to find in a massive structure such as this, intended—for whatever reason—to be very carefully oriented. They are such, in fact, as could not but exist in a building oriented so successfully as the Great Pyramid unquestionably is, unless some utterly incredible chance had enabled the builders, by an imperfect method, to hit accidentally on so perfect an orientation. Even then, in passing from the ground level

to higher levels, they must inevitably have lost the perfection of their orientation, unless they had had such means of keeping their work correct as we find they had. This being so, the chances being practically infinite against their first obtaining, and afterwards retaining, such accuracy of orientation, without long, slant passages, such as we find within the Pyramid, we are logically justified in saying it is *certain* that the passages were used in that way, and were intended originally to subserve that purpose.

The case is somewhat altered when we reach the point C, where the ascending passage ceases to be of the same small square section as the descending one. Up to this point its purpose is obvious. But so far as *mere* orientation was concerned, there seems no reason why it should not have retained the same section to a higher level. It is true that the nearer it approached to the central line, LF,* the less effective its directive value; but certainly this value would not be increased by increasing the size of the passage, whether in a vertical or a horizontal direction; and from and after the point C it is increased in both directions.

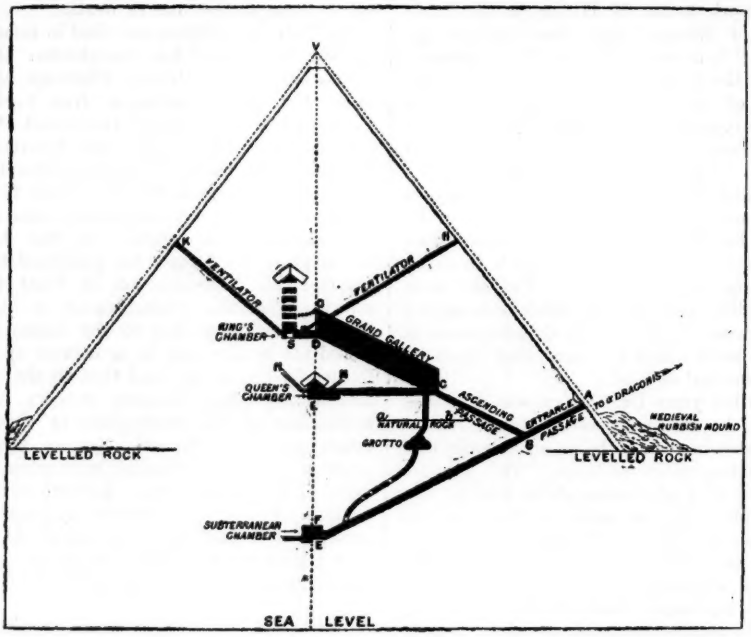

Fig. 1.

Now, we are certain that the builders of the Pyramid wanted to orient it very carefully, simply because we find that they did so. We do not know *why* they did. But it seems antecedently unlikely that *all* they wanted was to get the Pyramid perfectly four-square to the cardinal points. The natural idea is, that being, as we see by their work they were, astronomers of great skill, they had an astronomical purpose of some sort. They had thus far been working with manifest reference to the meridional plane, just as an astronomer of our own time would; and it looks very much, even from what we have already seen, as though they had considered this plane for the same reason that the modern astronomer considers it—viz., because this is the plane in which all the heavenly bodies culminate, or attain the middle and highest point of their passage from the eastern to the western horizon. They might have had only a fancy for exact orientation, though one can hardly tell why they should. Still, men of different races have taken strange fancies, and, unlikely though it seems, this might have been such an one, just as the building of colossal tombs seems to have been.

At the point C, however, all doubt ceases. The astronomical nature of the builders' purpose becomes here as clear and certain as already the astronomical nature of their methods has been. For from here upwards the small ascending passage is changed to one of great height, so as to command a long vertical space of the heavens, precisely as a modern astronomer sets his transit circle to sweep the vertical meridian. The floor, however, of the ascending passage, and even its sides, are carried on unchanged in direction, right up to D, where the central vertical (see preceding note) meets the ascending gallery. So that from B to D, except where the horizontal passage CL to the so-called Queen's Chamber is carried off, the floor of ascending passage and gallery formed a perfectly uniform slant plane.

And here let us pause to inquire—seeing that the astronomical purpose of the passages is made manifest—what shape an astronomer, who was also an architect, would give to the great ascending slit, as it were, through which the transits of the heavenly bodies were to be watched. As an astronomer, he would like it to be very high and relatively narrow; but as an architect, he would see that the vertical section could not have such a shape as *ABCD* in Fig. 2; for then, not only would the side walls, *AB*, *BC*, be unstable, but the observer would not be comfortably situated. Yet, as an astronomer, he would know that such a shape as is

* This line is not vertically below the vertex, V, but central, in the sense of being the vertical line where the horizontal north and south line from the ascending and descending passages crosses the east and west plane through the vertex.

shown in Fig. 3 would be unsuitable. To mention only one case out of many, supposing he wanted not only to observe a transit of a heavenly body along such a course as p_1, p_2, or q_1, q_2, which during the short time the body was visible would be practically a horizontal line, but also by observations on successive nights to determine the course of a heavenly body on the star sphere along a path as P_1, P_2, which might be inclined: then, the slant of the walls would entirely defeat his purpose. He would require, as an astronomer, that the walls should be absolutely vertical

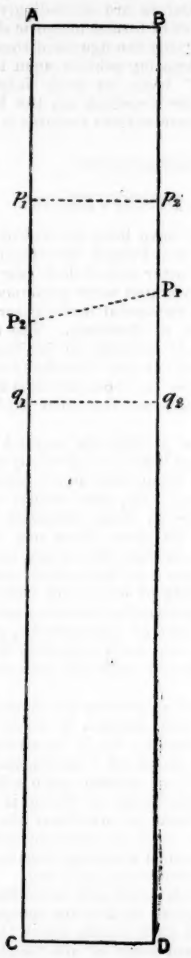

Fig. 2.

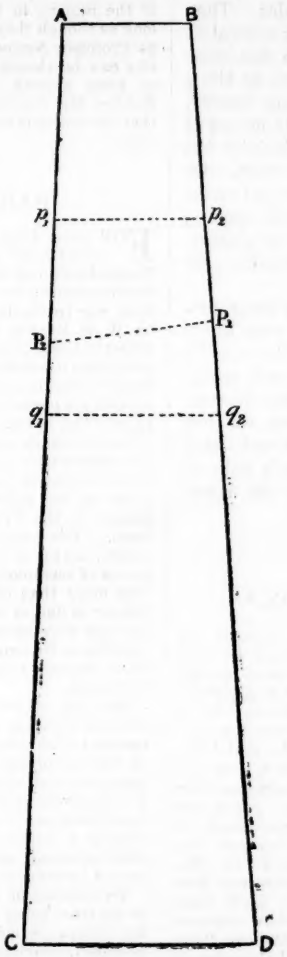

Fig. 3.

(note the difference between the paths p_1, p_2, q_1, q_2, P_1, P_2, in Fig. 2, and the similarly-lettered paths in Fig. 3), while as an architect he would know that they must be closer at the top than at the bottom of a passage so lofty as the great ascending gallery. Fig. 4, giving the actual shape of the vertical section of the great gallery, shows how the astronomical architects of the Great Pyramid combined both qualities. Every part of the walls is absolutely vertical, and yet the walls, regarded as wholes, are aslant.

If we had not seen from the beginning the astronomical plan of the Great Pyramid, and that such a plan indicated an astronomical purpose, we should find, I take it, in this double character of the ascending gallery, proof positive that it was intended for astronomical observations. Only an astronomer would have set the architect such a problem.

But it may be said, How are observers to be stationed along a slant gallery such as this, with smooth and much-inclined floor? Is not the idea that such an unstable place was intended for exact astronomical observation almost as

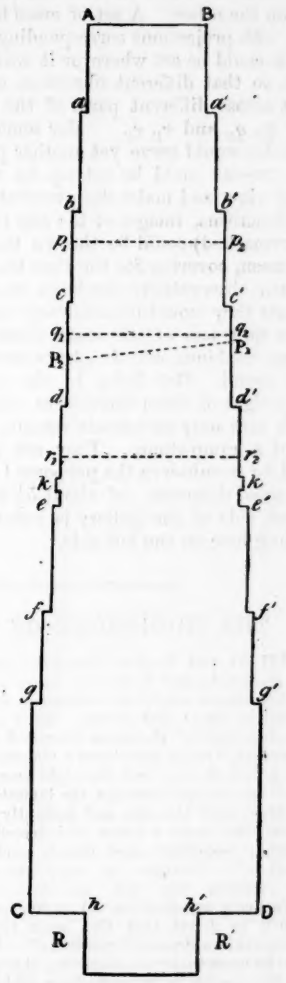

Fig. 4.

absurd as the notion that the top of the Pyramid was meant for that purpose?

Certainly, if a modern astronomer were planning a slant gallery for transit work he would arrange for comfortable observation (the only observation which can be trustworthy).

Now the ramps, as Prof. Piazzi Smyth calls them—the long slant stone banks, shown in section at R and R′ in Fig. 4—seem as if they had some reference to such a purpose. They are at a convenient height above the level of the slant floor, insomuch that Smyth pictures his Arabs leaning on them, stepping on to them, and so forth. But

they would not serve of themselves to make observations easy. The observer has to be set in the middle of the gallery (at whatever point of its length he may be), and he ought to be comfortably seated. I think, if I were planning for his comfort (which means fitness to make good observations), I should have seats set across from ramp to ramp. They must be movable, of course. And if there were not something along the ramps' upper surface to hold them, they would slide down, carrying the observer most uncomfortably with them. I should, therefore, have holes cut out along the tops of the ramps at convenient distances; the holes on one side being exactly opposite those on the other. A set of cross benches should then be made, with projections corresponding to these holes. Then a bench could be set wherever it was wanted, or several at a time, so that different observers might watch the same transit across different parts of the field of view, as along p_1, p_2, q_1, q_2, and r_1, r_2. For some observations, indeed, such holes would serve yet another purpose. By means of them, screens could be set up by which to diminish the field of view and make the observations more exact. Or on such screens, images of the sun (showing the sun spots, be it remarked) could be thrown through a small opening on a screen, covering for the time the mouth of the gallery. For such observations the holes would be convenient, for the seats they would be absolutely essential.

Now no traces of the seats themselves, with their projections, cushions, &c., &c., have been found or were likely to be found. But holes in the ramps are there still; twenty-eight of them there were originally in each ramp, though now only twenty-six remain, owing to the destruction of a ramp-stone. They are situated just as they should be to subserve the purposes I have mentioned—that is, at equal distances (of about $5\frac{1}{2}$ feet), and each hole on the east side of the gallery is exactly opposite the corresponding hole on the left side.

THE TRUE STORY OF THE MOON.*

GALILEO and Kepler, Huyghens and Hevelius, Cassini, the Herschels, and a host of other astronomers have tried in vain to interpret aright the telescopic aspect of the moon, during a period of about 270 years. Tired at length of being "une femme incomprise," the moon obtruded herself, Mr. Jones tells us, on his sight, "in so prominent a manner that she seemed to say, 'take a look at me,' and the night was so favourable, that" Mr. Jones "felt bound to accept the invitation." "Round went the tube, down went the eye, and instantly I telescopically gazed for the first time upon a scene of indescribable beauty; gazed and wondered, wondered and gazed, and for a time could do no other." Strange to say, the true meaning of the lunar scenery did not at once present itself to Mr. Jones's lively imagination. A second evening he observed her, and still he "felt that the lunar rings and plain walls were monuments of a departed greatness." But on the third occasion when the opportunity of observing the moon was embraced, "the moon was young, in crescent phase, and the structural character of the rings about the terminator came out beautifully. And now, O, volcanic theory, as commonly understood, thou art doomed. . . . Yes, there can be no mistake, *the ring mountains of the moon are the atolls of an ancient ocean which once overspread that luminary*, and the lunar walls, both of the ring mountains and walled plains, are organic structures, strictly analogous with the coral reefs of the terrestrial oceans, while the whole aspect of the lunar structures indicates that they are principally of similar carbonate of lime texture."

Mr. Jones is not only quick in forming novel views, but expects his readers to be equally quick in grasping them. He gives half a page more to a comparison between the lunar features and those described in Darwin's and Dana's books on Coral Reefs and Coral Islands, and, forthwith, "thinks that enough has been said to enable the reader to find out for himself that the craterology of the moon, and the theory which regards the lunar walls and reefs as direct products of eruption, is a *pure myth*."

Probably *we* have said enough to enable the reader to find out for himself that Mr. Jones's theory is pure nonsense. There is not the slightest resemblance between the lunar craters and coralline structures, whereas there is the closest possible resemblance between the lunar features—craters, mountain ranges, high tablelands, and level plains—and those terrestrial features which result from subterranean forces, or what Humboldt calls the reaction of the crust against the interior. Mr. Jones says there are some astronomers who have ventured to doubt the volcanic character of the lunar asperities, citing, as an instance, the Editor of KNOWLEDGE. He is as much mistaken in this as in his coralline theory (he could hardly be more). The remarks of the Editor, that some of the regions in which small craters are exceedingly numerous look as though they bore the marks of former meteoric showers, or, as Professor Newcomb puts it, "that the figures of these inequalities can be closely imitated by throwing pebbles upon the surface of some smooth plastic mass," bears no such interpretation. Neither Mr. Proctor nor Professor Newcomb has the least doubt that the volcanic theory of the lunar surface features is essentially true.

* "First Steps to Selenography." By John Jones. (John Leng & Co., Dundee.)

BABYLONIAN DISCOVERIES.

FOR some time past rumours have been current of great discoveries by an agent of the French Government in the Mesopotamian valley, and in the latter part of last year they took definite shape; the antiquities excavated were announced to be on their way to the Louvre, and the successful investigator proved to be M. de Sarzec, French Consul at Bussorah. The cases have recently been unpacked, and their contents so far fulfil the expectations created, that M. Oppert, at the "Academy des Inscriptions," has pronounced them to be the most priceless treasures of ancient art contributed to Europe since the great explorations of Layard and Botta.

In the *Gazette des Beaux Arts*, a preliminary account of some of the statues which form part of the "find" is given by M. Menant, an Assyriologist, accompanied by some exceedingly beautiful heliotypes of the objects themselves. This, and several other short notices in the French press, furnish these intensely interesting facts. The antiquities, which all come from one magnificent palace, are of all kinds—sculptured slabs, bas-reliefs, statues, fragments of terra-cotta, and numerous inscribed bricks, some of them with more than one hundred lines of cuneiform writing. Great honour is due to M. de Sarzec for rescuing these valuable remains, for they were buried beneath a part of Mesopotamia, close to the junction of its two great rivers, deep down in alluvial deposits, and their recovery required much greater exertions than that of relics in Assyria.

Had this collection only contained further additions to the fast-growing remains of Babylonia and Assyria, it would have been received with delight by archæologists, but it fortunately presents us vestiges of another primitive people of Chaldea, the riches and importance of whom are probably at present quite unappreciated. The inscriptions (any full interpretation of which is as yet unattempted) are in very archaic forms of cuneiform characters, and embody a dialect quite distinct from the Semitic Assyrian, but whether closely allied to, or identical with, the so-called Accadian, cannot be pronounced from the fragments published.

Two statues of diorite, of which admirable facsimiles are given, so far from being inferior precursors of Assyrian sculptures, are, if anything, superior to the work of that people which they certainly preceded, proving a far advanced stage of art for the nation by whom they are executed. One is of a person seated, the other an upright figure, both, unfortunately, decapitated, a condition which seems to be that of all the statues exhumed. Each figure is clothed in a long robe reaching to the ankles, but the correct outline of the body is distinctly visible below the folds of raiment, as in the best periods of sculpture, and the delicate arrangement of the drapery is most pleasing. The feet, which are quite naked, are carefully executed. The whole lower front of the dress of the seated statue is covered with cuneiform writing of very old type, apparently closely allied to the extremely ancient texts, from which the Rev. W. Houghton proves the hieroglyphical origin of the cuneiform characters.

This seated figure appears to be that of an architect, for, on his lap, is a tablet inscribed with a plan of a building, and some instrument connected with architecture. The erect figure, if anything more correctly carved, has a few lines of writing on the right front of the robe and the right arm. The attitude of the arms is in

both precisely similar, and so, probably, conventional, but well suited to the character of repose given to the statues, they being crossed before the body, the right hand lower, and holding the left. The loss of the heads of these figures is greatly mitigated by the possession of the exquisite head (belonging to a statue not yet found), a copy of which is given. It bears an embroidered head-dress similar in shape to the old Cossack shako. This, and a fragment of ornament from a marble slab, completes the series of illustrations at present published.

As might be expected from a "savant," M. Menant concludes his monograph by a theory, and as it is one which, if correct, tends greatly to support his previous arguments, it need not be said he urges it with great confidence. For many years the advanced school of cuneiform decipherers had, without exciting much opposition, decisively declared the old Accadian tablets to be in a Turanian tongue, a language allied to that of the Tartar and Finnic families, but lately this has been called in question most determinedly by M. Halévy, one of his arguments being, that if this Accadian dialect were (instead of being, as he declared, merely an esoteric priestly writing, intended by the initiated to be unintelligible to ordinary readers) a language complete in itself, inherited from a prior civilisation, where are the remains of this primitive people? Especially were he and his followers dubious as to a Turanian civilisation, Turanians being celebrated in history rather by the destruction than evolution of culture.

Now, here are the complete remains of an advanced state of art and consequent wealth associated with numerous inscriptions of great difficulty in a writing allied to the alleged Turanian Accadian, or, at least, certainly separate from the Semitic Assyrian. To M. Menant, an advocate of pre-Turanian culture, the opportunity is too good to resist, and he triumphantly avers that here the "blow of a pickaxe" has presented the missing proof.

Do the monuments themselves offer support to either side? None; their evidence is only negative; still, it is decisive as far as it goes. The physical characteristics of the head are certainly non-Turanian, and as decidedly non-Semitic. The features are of a high type of beauty, allied to the Greek or Caucasian. Again, the statues have no analogy either with Assyrian, Egyptian, or Hittite art. If a resemblance must be sought, it would be found nearest in the figures from Branchidæ, obviously only a resemblance, not a real connection. To impartial observers this result is not a surprise, for whilst the Turanianists and Semiticists have been refuting each other, they remember that in the old ethnological list, never yet contradicted by research, Cush is said not to be a son either of them or of Japhet, but of Ham. These wonderful discoveries furnish one certain lesson, taught before in Egypt, that it is not an invariable rule that the greater the antiquity of relics of the past, the greater the inferiority of execution they present. For the last thousand years of its history, the architecture of the Nile valley presents only a decline; here, again, by the Euphrates and Tigris, the earliest appears in some respects to have been the better. Was there, then, a still higher art before this again; who shall say? Only a few years ago, Egypt and Chaldea were accounted the first of nations, and the existence of a great Hittite people only to be inferred from a casual statement by Masoudi, an Arab historian.

All that can be said is, that whatever wonders are still buried beneath the soil of Western Asia can only be revealed by the spade. M. de Sarzec has wielded it lavishly and to good purpose, and deserves the gratitude of scholars and all who desire to know the history of the human race, the world over.

A MEMBER OF THE SOCIETY OF BIBLICAL ARCHÆOLOGY.

INTELLIGENCE OF THE HOUSE MARTIN.

IT is a common delusion, founded upon imperfect information, that animals guided by instinct do not modify their proceedings by reason, but persevere in a mechanical repetition of the same acts. Probably no creature with a complex nervous system that was observed with sufficient attention, under a variety of conditions, would be found so deficient in intelligence as this theory imagines. At any rate, it completely breaks down when applied to our common birds, and quite fails to explain the kind of facts to be narrated concerning the house martin. A cottage of many gables, situate on the slope of a wide heath, was for many years a favourite resort of this sociable bird, and in one season as many as thirteen nests were established. Now, according to the instinct theory, they ought to have been all alike, but in eleven cases there were obvious differences, some slight in appearance, but probably all-important for the stability of the erection or the comfort of its inhabitants. The simplest nest was quite open at the top, sheltered by projecting eaves, and very roughly finished at the margin. Another variety was built quite up to the woodwork, and had a side entrance left in the rough. Others had similar side entrances, neatly finished with a rounded border. On a north-western gable, quite on its top corner, repeated efforts had been made to construct a nest which would brave the storm winds, and after several failures and mendings, a sort of buttress was stuck on below, evidently a new idea. On the southern side, a favourite locality was under a projecting window, sufficiently high above the sill of a lower window that no cat could reach it by a jump. In this situation the birds built twin nests—semi-attached houses, and they placed their doorways close to the wall on opposite sides, so that when looking at them, the left abode had its entrance on the extreme left, and the right one on the extreme right. If the entrances had been in any other position, the birds might have jostled in going in and out. The walls of the cottage being rough cast, offered a good foundation, but there is no tenacious clay near, and the martin architects were never quite successful with two of the highest gables, possibly on that account. Mischievous sparrows occasionally stole a nest, but the right birds were generally very comfortable, and reared their broods prosperously. It was, therefore, a matter of surprise that, after coming for many successive years, repairing old nests, and making new ones, they merely looked at the place, and did nothing in the summer of 1881. The weather was unfavourable, the birds arrived late, and prepared houses some way off, perhaps from their offering more sheltered situations. Towards the close of the martin season, the custom of the old birds for many years was to give the young ones some building lessons, and lines of foundation, several feet long, were usually attached to the cottage walls. Some of them served for the commencement of nests in the following season, but most of them seemed merely school exercises. If these acts were all done under blind instinct, there is a kind of blindness much like seeing, and it may be doubted whether the mud huts of the poor Irishmen exhibit much more intelligence than the martin's homes.

HENRY J. SLACK.

INTELLIGENCE IN ANIMALS.

ON reading the article "Intelligence in Animals," page 177, and also the previous one on "Brain Troubles," page 175, it struck me that human beings might, perhaps, lessen their "brain troubles" and improve their "intelligence" by trying to acquire a curious habit possessed by some animals, especially the dog. I allude to the way they have of saving themselves up, so to speak, when not on duty, which nearly everyone must have noticed, and which the following instance will illustrate:—They have, at my father's house, a small black and tan terrier, Toby III., who has taken upon himself the duty of escorting all strangers to the door on their leaving the house. On the slightest sign of a departure, Toby, although lying on the sofa snoring and apparently fast asleep, instantly starts up in a fearful state of excitement, and with every appearance of undying fury and hatred, fairly screams the visitor out. In less than a quarter of a minute he is once more comfortably asleep. It would be interesting to know how dogs have acquired this enviable knack of disengaging their attention when not required; perhaps it is partly because they are, unlike "the literary gentleman," not "exposed to much anxiety respecting family matters."

Some time ago a friend brought us a small terrier, under the impression that it was our Toby that had got lost. It was an amiable little creature, and, unlike Toby, willing to make friends with anyone. On being noticed, it would look up, shake its head, and actually *laugh* with satisfaction. If laughter be a sign of intelligence—and it is an attribute generally supposed to be confined to the most intelligent of all animals, man—our little friend must have been quite an "infant phenomenon." This is the first instance I know about of a dog laughing; but my wife assures me they had a dog which, although bold and courageous, would, on being left in the house alone, cry "real tears," just like a child.

J. H.

GHOSTS.

I AM asked by "T. D." [204 and 205] to explain the "War-Office Ghost," in which, he says, three friends, in different parts of England, saw a fourth friend at the corrected date of his death abroad. And Mr. Ebenezer Kelby cites the case of Lord Brougham (mentioned, if I mistake not, in his Autobiography), in which that illustrious statesman is said to have beheld a friend's "ghost;" the "ghost" appearing to him, by mutual pre-mortem agreement, as the spectre of the first deceased of the two. In reply, permit me briefly to say, that before one can form an opinion upon any such

apparently mysterious cases, one must have full and complete evidence, not only of times and seasons, but of all other circumstances connected with each case. There must be no shadow of discrepancy—no lack of complete and full agreement in every jot and tittle of evidence, before a scientist can take the case under his consideration.

To lay the explanation of such cases within the domain of the supernatural, because we may not be able exactly to satisfy others or ourselves of a rational cause for them, is, of course, but a sorry way of escape from our difficulties. But I have, at least, one idea to fall back upon in treating of so-called "warning dreams," and the appearance of apparitions at expected and unexpected times, and that is, the idea of *coincidences*. If a person tells me he dreamt of a person's death, and that the person can be proved to have died at the moment he dreamed of the event, or even if he tells me he saw the apparition of his deceased friend, I reply that he may be indulging in the fallacy of *post hoc ergo propter hoc*. I would further reply—being a disbeliever in "ghosts" of all kinds as visitations from the nether world, at least—that the explanation of these events does not lie outside the doctrine of coincidences. It is, in other words, a mere fortuitous circumstance that the dream or the "ghost" (*i.e.*, the *subjective* image in one's own brain) has appeared at the time (not always exact) of the person's death. If I can show that as startling coincidences occur in our waking life, I may claim to have, at least, shown the possibility and probability of their occurring in the case of dreams and ghosts. Here is one well-known coincidence, as startling to my mind as any ghost story I have ever heard. I quote from my recently published "Naturalist's Note-Book" (Chatto & Windus), page 39:—"The well-known case of Joseph Lesurques, whose misfortune forms the incident on which more than one melodrama and novel has been founded, has recently been brought anew under public notice through Mr. Henry Irving's performance in the 'Lyons Mail,' and by his assumption of the dual *rôle* of Lesurques and his villainous double. The case actually occurred in France in 1794, and its details are sufficiently well known to obviate the necessity for their repetition here. Charged with robbery and murder, the innocent Lesurques was recognised, identified, and sworn to as the real culprit by various disinterested witnesses. Notwithstanding strong exertions which were made to save his life, and, despite his previous high moral character and probity of conduct, Lesurques was sentenced to death, and executed. Soon afterwards, the real culprit, a man who bore the closest possible likeness to Lesurques, was brought to justice. It was then seen that the similarity in features, stature, build, and manner was so close as to have deceived the witnesses who gave evidence at the trial. On these grounds alone, and as a matter of common recognition and identification, the unfortunate resemblance of Lesurques to the real culprit had unwittingly led them into a 'Comedy of Errors,' which resulted in a legal tragedy as its *dénouement*. But more extraordinary to relate still is the incident, well-nigh unparalleled in the annals of coincidences, that Lesurques was marked by a scar on the forehead, and by another on the hand, whilst the real criminal likewise possessed similar markings. Surely "the grim irony of Fate" could no further go than this, in causing chance likeness to assume a form and to entail consequences so fatal and sad as in the case of Joseph Lesurques."

And, lastly, as to a "ghost" being seen by more than one person, or regarding the possibility of several persons being collectively deceived, let me relate the famous case of the Crystal Palace fire. When the wing of the Palace was burnt the animals in the menagerie were believed to have perished in the flames. But, as the flames progressed, the eager and excited crowd of spectators were horrified to behold the chimpanzee struggling to escape from a horrible death on one of the pinnacles of the building. With eager eyes the crowd followed every movement of the ape, and loud was the sympathy for the unfortunate animal. Imagine the sequel. When the chimpanzee was more nearly approached, the object which, to the eyes of thousands, had presented the exact reproduction of an ape, was discovered to be merely a fluttering rag of canvas, the movements of which had simulated in their eyes the attitudes of the monkey. After the occurrence of such an incident, I must be pardoned if I feel somewhat sceptical, even when the united testimony of two or three persons is hurled at my head by way of convincing me that a ghost was thereby necessarily proved to be no mere figment of the brain.

ANDREW WILSON.

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ARTIFICIAL INDIGO.

IT may be interesting to many readers of this magazine to know something about the production of the dyestuff indigo by artificial means, for it is now to some extent obtained practically by the chemical process known as synthesis, from one of the constituents of the tar obtained from the distillation of coal for the production of gas.

Previous to the introduction of this colouring matter into Europe, about the middle of the sixteenth century, the indigo contained in wood (*Isatis tinctoria*) was employed for dyeing, although the Romans and Greeks used indigo for painting; up to the present time the name "wood" is still in vogue in many dyeworks, the vats in which the dyeing is carried on being called "wood vats" and the dye-house "wood-house."

The following is intended to give a short account of the manner in which this valuable colouring matter, so largely produced in India from the cultivation of the indigo plant, is built up by chemical processes. Indigo is composed of carbon, oxygen, hydrogen, and nitrogen, and is represented by the formula C_8H_5NO, showing the number of atoms of each of its elementary constituents. The naphtha obtained when coal tar is distilled, contains a number of chemical compounds—benzol, toluol, cumol, &c.; it is from the second of these (toluol, C_7H_8) that indigo is obtained. By adding an atom of oxygen to indigo, Erdmann and Laurent formed a compound named isatin ($C_8H_5NO_2$); and afterwards Baeyer succeeded in converting this compound back again into indigo by the reduction of its chloride; and from a knowledge of the constitution of this isatin, the two chemists, Claissen and Shadwell, have succeeded in building it up from a nitro compound of benzoic acid (called ortho-nitro-benzoic acid). It is pretty well known that this acid is contained in gum benzoin, from which it was exclusively obtained until within the last few years. Now, however, it is produced from toluol by simple but interesting chemical processes. The nitro-compound of benzoic acid has one of its hydrogen atoms displaced by chlorine, and on bringing this chloride in contact with silver cyanide, the chlorine and cyanide exchange places, forming the insoluble compound silver chloride and the nitrite. This nitrite, heated with potassium hydrate, exchanges the cyanogen for an atom of oxygen and hydrogen, producing ortho-nitro-phenyl-glyoxalic acid and potassium cyanide. The oxygen associated with the nitrogen forming the nitro group, is displaced by a similar process to one already largely employed for converting the nitro compounds of benzol, toluol, &c., into their corresponding amines or amido compounds (aniline toluidine); that is, by contact with nascent hydrogen by the abstraction of water from the amido compound just formed from ortho-nitro-phenyl-glyoxalic acid isatin is obtained, which, as we have already seen, can be converted into indigo by the process discovered by Baeyer.

This chemist has also succeeded in producing isatin by another process from toluol, first producing phenyl-acetic acid.

The colouring matter is obtained practically by Baeyer from a compound found in gum, benzoin, and other natural products, known as cinnamic-acid. This is the process employed:—The acid produced by natural means being too expensive, its synthesis is resorted to; toluol is also, in this instance, the starting-point; it is by the substitution of one of its atoms of hydrogen by chlorine, converted into a compound named benzyl chloride, which, by a proper treatment with nitric acid, is converted into oil of bitter almonds by the displacement of one atom each of the monatomic elements, hydrogen and chlorine, by the diatomic element oxygen. This oil is also called benzaldehyd. It was discovered in 1856 by Bertagnini that this compound, on treatment with acetyl-chloride, is converted into cinnamic-acid. W. H. Perkin, F.R.S., has, however, discovered a more practical and cheaper method for the synthesis of this acid. Two atoms of hydrogen in the toluol are substituted by two of chlorine, forming benzyl-dichloride, and this compound, heated with acetate of soda, yields cinnamic acid. Acting on this acid with nitric acid there is formed a nitro-compound—the ortho-nitro-cinnamic acid. This is caused to combine with two atoms of bromine, by which the dibrom-nitro-phenyl-propionic acid is obtained. By the treatment of this last-named compound with caustic soda or potash, the two atoms of bromine are removed, forming sodium bromide, whilst two atoms of hydrogen are also removed, forming a molecule of water, thus producing a new compound having two atoms of bromine and two of hydrogen less than the last-mentioned compound, the new product being ortho-nitro-phenyl-propiolic-acid, and this, by reduction with hydrogen, forms indigo, carbonic acid, and water. It is the ortho-nitro-phenyl-propiolic-acid which is supplied to the calico printers, who, on printing its alkaline solution with a reducing agent, form an indigo white on the fabric, and on steaming it is oxydised into the pure indigo blue. M. Rosentiehl says, "a mixture of gum water containing the above-

mentioned acid, along with carbonate of soda and glucose" is printed. "The design is scarcely visible at first, all the substances being colourless. But if the cloth is exposed for two minutes to a temperature bordering on 100° C the design appears, and the formation of indigotine (*i.e.* pure indigo) is so plentiful that the colour appears black. Washing with water removes the soluble matter, and indigo blue becomes visible with all its characters, and is intimately fixed upon the fibre." Although the manufacture of this interesting compound has been, according to the *Textile Manufacturer*, given up by one Continental factory, it undoubtedly only remains a matter of time for the further and more practical development of this new industry, and most probably it will become as successful a competitor with the natural product as alizarine is with madder, the cultivation of which has almost ceased, the beet being cultivated in its place for the manufacture of sugar.

SCIENCE AND RELIGION.

A CORRESPONDENT writes:—"I find fault with the *seeming* tendency of science to account for all 'physical' and 'chemical' laws as being merely due to certain fixed laws of nature. Scientific men may say that by nature they really mean God, or that nature was made by God; but the fact remains, that those who learn may or will say Nature does everything herself, there's no need for a God. Lecturers are too fond of such words as the following: 'These are the means by which Nature works. In this case Nature adopts such and such a course." When some weak-minded people (and there are many such) are constantly hearing the one refrain of the whole law of existence, being merely a question of 'chemical' decay and 'chemical reproduction,' they say there is no God but these; they will perchance ask the question—"Was there ever any beginning? Will there ever be any end?' One of our great men made use of the words that man was nothing but a 'shovelful of phosphates.' Such words spread quickly, not for good but for much evil. These, sir, are the points to which I would draw attention. I, for one, would gladly see a really good correspondence anent this matter. Yet even in this case, I would fear that some of the arguments advanced on the side of science would cause much mischief amongst those of weak minds or weak faith."

[We receive so many letters of this kind, that we think it well to admit so much as we have quoted of our correspondent's letter (all that is essential to the argument has been left); but it is only allowed to appear as the Helots were allowed by the Spartans to show the bad effects of indulgence. To the kind of correspondence which our correspondent invited (yet deprecates, though seeking to initiate it) our columns are emphatically not open. We can neither suffer scientific facts to be advanced as oppugning nor as supporting specific religious doctrines. If scientific statements were made here which seem, whether to "those of weak mind or of weak faith," or to able reasoners, to be opposed to religious doctrines which they hold, our correspondence columns would be open to scientific objections to such statements. They would be open to letters showing how such statements may be reconciled with the religious doctrines apparently oppugned, if they were open to suggestions on the other side. But the balance will be held fairly so far as lies in our power. We regard the wider questions of natural religion as within our scope, but those who wish to attack specific religious opinions from the side of science must seek some other arena; and so also must those who wish to attack science from the side of religion. Our purpose here is to seek for scientific truth. We are in no way concerned with the religious tenets of our contributors or correspondents. Those, on the one hand, who are unsatisfied with science unless used as a weapon wherewith to attack religious opponents; and those, on the other, who ask, first, not whether a scientific statement is true, but whether it can be reconciled with their religious views, will find science, as treated in these pages, altogether unsatisfactory to them. If there are few who do not belong either to one category or to the other, we shall have to admit that KNOWLEDGE is a mistake. But we should not change our plan; we should simply abandon our purpose.—ED.]

SEPARATE SOUNDS ON ONE WIRE.—M. Maiche has found by experiment that sounds of different characters produced from two separate sources can be sent simultaneously on one wire and received separately. He used at the receiving station two telephones of different resistances, and at the transmitting station caused a musical box to be set going on a microphone of small resistance, while an induction telephone transmitter was spoken into at the same time. The musical sounds were reproduced in the telephone which had the least resistance, and the vocal sounds in the other, so that with the two telephones to the ears, the music could be heard by one ear and the speech by the other.—*Scientific American.*

THE FRENCH SOCIAL PROBLEM.—At the beginning of the present century, with a population of not more than twenty-seven millions, there were actually more births in France than took place in the year 1880. M. Legrand, in his well-known essay on "Le Mariage et les Mœurs en France," states that between 1800 and 1815 the number of children born per marriage averaged 4·24; since then it had sunk gradually, and in 1860 averaged only 3·03 for the five preceding years. It rose again until 1865, but has since declined; and in the year 1871, the date of the Franco-German War, reached its lowest depth of 2·26. In 1872 the average rose to its highest for the last few years, namely 2·67, and in 1877 it was 2·55. M. Legrand asserts, on the strongest possible grounds, that this decrease in the birth-rate of his country continues, and is becoming more marked as the years go by. It is a noteworthy and, perhaps, ominous fact, that lately the number of marriages have not decreased. Indeed, there are actually more marriages per cent. in France than in England, the average per hundred being in the former ·88, and in the latter ·86.

ASBESTOS FIRE-PROOF PAINT.—A series of interesting experiments on a practical scale were recently carried out in the grounds of the Crystal Palace with asbestos paint, in order to test its qualities as a protective covering against fire. This paint is a new and special preparation of asbestos, and is being introduced by the United Asbestos Company, of 161, Queen Victoria-street, E.C. The asbestos in a finely divided state is mixed with a fluid material, and is used in a similar manner to other paints. Unlike them, however, it is uninflammable, and not only so, but is capable of communicating this valuable attribute to such substances as it may be applied to. This applies alike to cotton fabrics and to timber or other inflammable materials used for constructive or decorative purposes. Hence its great value in connection with theatrical properties and appliances, especially those connected with the stage arrangements. It was to demonstrate this valuable feature that the experiments were carried out, in the presence of the Lord Mayor and Lady Mayoress, the representative of the Lord Chamberlain, Captain Shaw, and a number of other ladies and gentlemen who had been specially invited, besides the visitors at the Palace generally. The first experiment consisted in submitting to the action of fire some linen, cotton, and gauze fabrics which had been partially treated with the paint. On setting fire to them, the unprotected portions quickly blazed away into tinder, the protected parts remaining intact. The next experiment consisted in placing on one part of a fierce fire some blocks of wood painted with asbestos paint, and on another part similar blocks of wood not painted. In the course of a short time the unpainted blocks were entirely consumed, while those which were painted resisted the action of fire for a long time without showing signs of deterioration. At length, however, the fierce heat of the fire raised some blisters, which on bursting admitted the intense heat, which charred the wood, the external coating of paint, however, being greatly preserved. In the final experiments, four timber erections were employed, two being about 12 ft. wide by 8ft. deep and 10ft. high, and representing theatrical stages, with ropes, curtains, and effects. The other two were open timber sheds, about 6ft. square in plan and 8ft. high. One of each of these two classes of structures was protected with the asbestos paint, the other two being of plain timber. Piles of shavings and other inflammable materials were placed under and upon the floor of each structure, and lights were applied to all simultaneously. The unprotected stage quickly caught fire, and in about twelve minutes it was a heap of blazing ruins. The unprotected shed, being open-sided, did not take fire so soon nor burn so rapidly, but the flames eventually got hold of it. Both the protected stage and shed resisted the effects of fire to the end most successfully, although inflammable materials, including naphtha, were occasionally employed. In the course of half-an-hour some portions of the fittings were found to be smouldering away, but at no time was there any outburst of flame from the protected materials. The interior of the woodwork, however, was well blistered, but the wonder is that it showed so little evidence of damage. The gauze and lighter fabrics disappeared at an early stage, but only by crumbling gradually away in an incandescent condition, and never once by bursting into flame. These results are highly satisfactory, and fully demonstrate the value of the asbestos paint as a fire-resisting medium in respect of its application to theatrical stages and effects, or, in fact, to any other structures or their fittings. On returning to the palace after the experiments the visitors were gratified by a private view of the concert-room, which was beautifully illuminated for the first time by the Edison electric light. The demonstration was distinctly not a public one, but was only the engineer's experimental trial of the engines and Edison machines, which have just been got in position.

XUM

Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

All Letters or Queries to the Editor which require attention in the current issue of Knowledge, *should reach the Publishing Office not later than the Saturday preceding the day of publication.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"There is no harm in making a mistake, but great harm in making none. Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

Our Correspondence Columns.

CHINESE CALCULATION.

[During my first visit to America, in the winter of 1873-74, a Chinese calculating man gave some remarkable proofs of the rapidity with which the persons of his profession in China can execute some of the common processes of calculation. His rapidity in executing long sums, or what with most would be long sums, in addition, was remarkable. A series of numbers, each of four digits, were named to him as fast as they could be entered by a clerk, and when the last of some thirty had been called out, he was told to add them together. "It is already done," he said, naming the total. When the numbers as entered by the clerk had been carefully added together, it was found that the total so named was correct in every figure. It seems to me that there is something in this feat which, though akin to the power some of our banking clerks possess of adding in a single operation numbers of four digits, yet so far surpasses that power as to indicate the use of some entirely different system of arithmetical training, for I am given to understand that what the Chinese calculator did, though it seemed so remarkable, fell far short of what many Chinese computers could do. In fact, I was told he was only an ordinary computer. Can any of our readers give any account of Chinese arithmetic, or of their processes of rapid calculation?—Ed.]

MIND-DOCTORS.

[224]—What Molière ridiculed in the doctors of his age is true, to some degree, of the mind-doctors of the present time; there is a tendency among them to threaten all manner of evil consequences from quite ordinary and familiar symptoms, unless their aid is quickly called in. It occurs to me, by-the-way (my momentary forgetfulness on the point is one of the slight symptoms in question, and not, I venture to assure myself, a sign of approaching mania), that in "Monsieur de Pourceaugnac," Molière has satirized the very tendency with which we are here specially dealing:—"Qu'ainsi ne soit," says the First Doctor to the Second, speaking of the unfortunate De Pourceaugnac, "pour diagnostique incontestable de ce que je vous dis, vous n'avez qu'à considérer ce grand sérieux que vous voyez, cette tristesse accompagnée de crainte et de défiance, signes pathognomoniques et individuels de cette maladie, si bien marquée chez le divin Hippocrate; cette physionomie, ces yeux rouges et hagards, cette grande barbe, cette habitude du corps, menue, grêle, noire et velue, lesquels signes le dénotent très-affecté de cette maladie, procédante du vice des hypocondres; laquelle maladie, par laps de temps, naturalisée, enviellie, habituée et ayant pris droit de bourgeoisie chez lui, pourroit bien dégénérer ou en manie, ou en phthisie, ou en apoplexie, ou même en fine frénésie et fureur. Tout ceci supposé, puisqu'une maladie bien connue est à demi guérie, car, *ignoti nulla est curatio morbi*, il ne vous sera pas difficile de convenir des remèdes que vous devons faire à monsieur," and so forth. Cerebrum.

SEA SERPENT, OR SEAWEED?

[225]—If I am rightly informed you are a believer in the sea serpent. The following extract from a daily paper may serve to change your ideas on that subject:—"A good sea serpent story—rather better than those which are often published about this time of year—comes from Madras, in the shape of reminiscences of Captain Taylor when lying at anchor in Table Bay some years ago. One day an 'enormous monster,' about a hundred feet in length, was seen advancing with snake-like motion round Green Point into the harbour. The head appeared to be crowned with long hair, and the keener sighted amongst the observers could see the eyes and distinguish the features of the monster. The military were called out, and after peppering the object at a distance of five hundred yards, and making several palpable hits, it was observed to become quite still, and boats ventured off to complete the destruction. The 'sea serpent' proved to be a mass of gigantic seaweed, which had been undulated by the ground swell, and had become quiescent when it reached the still waters of the bay. Probably if mariners would attack the 'monster' in the same manner whenever it is seen, we should hear little more of the sea-serpent."—I am, sir, yours &c.," J. Dawkins.

[Mr. Dawkins appears to think that we have never heard of sea weed being mistaken for sea serpents. The following extract from an essay on Strange Sea Creatures, p. 223 of "Pleasant Ways in Science," may change his views in that respect:—"When the British ship *Brazilian* was becalmed . . . Mr. Herriman, the commander, perceived something right abeam, about half a mile to the westward, stretched along the water to the length of about 25 or 30 feet, and perceptibly moving from the ship with a steady, sinuous motion. The head, which seemed to be lifted several feet above the waters, had something resembling a mane, running down to the floating portion, and within about 6 feet of the tail, it forked out into a sort of double fin. Mr. Herriman, his first mate Mr. Long, and several of the passengers, after surveying the object for some time, came to the unanimous conclusion that it must be a sea-serpent. As the *Brazilian* was making no headway, Mr. Herriman, determining to bring all doubt to an issue, had a boat lowered down, and taking two hands on board, together with Mr. Boyd, of Peterhead, near Aberdeen, one of the passengers, who acted as steersman under the direction of the captain, they approached the monster, Captain Herriman standing on the bow of the boat, armed with a harpoon to commence the onslaught. The combat, however, was not attended with the danger which those on board apprehended; for, on coming close to the object, it was found to be nothing more than an immense piece of seaweed, evidently detached from a coral reef, and drifting with the current, which sets constantly to the westward in this latitude, and which, together with the swell left by the subsidence of the gale, gave it the sinuous, snake-like motion."

As a mere matter of detail, it may be remarked that there is some difference between the distance of half a mile in this case, of 500 yards in the other case, and in yet another case of a sea weed sea serpent 800 yards, and the distance of 200 yards at which Captain M'Quhae, and other officers of the frigate *Dædalus*, saw what they stated to be "beyond all question a living animal, moving rapidly through the water against a cross sea and within five points of a fresh breeze, with such velocity, that the water was surging against its chest as it passed along at a rate probably of ten miles per hour." Captain M'Quhae would not go after *his* seaweed because he saw he had no chance of overhauling it, so that for seaweed, travelling against the wind, it was tolerably active. Albeit Mr. Dawkins will not find a word in the essay above-named implying that we believe in the sea serpent. A paddling, long-necked sea creature, probably akin to the *Plesiosaurus*, seems suggested by that portion of the multitudinous evidence relating to supposed sea serpents which is trustworthy. Such a creature would not be a sea serpent, however.—Ed.]

COLD SATURATED SOLUTION.—MARINE BOILERS.

[226]—In answer to query 185, Thorpe, in *Journ. Chem. Soc.* for October, 1881, gives a method for estimating total salts in water. In the same Journal, Page & Keightley [2], X 566, give amounts of nitrate and chloride of K. and Na. in cold saturated solution. Can find no reference to methods in *Dic. Chem.*. If Messrs. G. & S. want a method for separate salts, there is no better way than adding excess of salt, heating and shaking, then cooling to 60° (this applies equally for common salt); or, if salt less soluble in hot water, saturate the solution at a lower temperature, and let it rise to 60° Then take 250 c.c. and make volumetric analyses. W. G. must be wrong in assuming that grease is present in boiler crust. Dust, or any substance that will not wet, make water spheroidal.

C. T. B.

INTELLIGENCE IN ANIMALS.

[227]—Reading to an old sportsman your article on this subject in No. 6, and the correspondence which followed, he related to me how he used to accompany a friend possessing a pointer (bitch), who, when her master missed three consecutive shots, would slink home, heedless of any calls to remain in the field. The friend alluded to was a first-rate shot, and rarely missed his mark, except after an evening's extra glass.

In thus administering a rebuke to her master, the animal, I think, exhibited a rare amount of humour. It could not be said that the dog herself was unmindful of her own duties, for on one occasion, when her master went home to lunch, returning after two hours' absence, she was found at the same spot where left, pointing to a hare lying at the bottom of a hedge. This, of course, was due to good training, but her conduct in the former instance must have been the result of reasoning. A. GAUBERT.

ELECTRICAL IMAGES.

[228]—Having been lately reading Maxwell's "Elementary Treatise on Electricity," I have been able to follow the reasoning and do all the mathematics except one part on page 85 relating to electrical images. The difficulty is to obtain his results without a clumsy and laborious process of multiplying. He says: "If we now write—

$$qaa = a + \frac{a^2 b}{c^2 - b^2} + etc.$$

$$qab = \frac{-ab}{c} - \frac{a^2 b^2}{c\,(c^2 - a^2 - b^2)} - etc.$$

$$qbb = b + \frac{ab^2}{c^2 - a^2} + etc.$$

the whole charge on the sphere a will be

$Ea = qaa\ Pa + qab\ Pb$,

and that of the sphere b will be

$Eb = qab\ Pa + qbb\ Pb$."

That is all clear enough. But he goes on to say: "From these results we may calculate the potentials of the two spheres when their charges are given, and if we neglect terms involving ^3b, we find—

$$Pa = \frac{1}{a}\ Ea + \frac{1}{c}\ Eb$$

$$Pb = \frac{1}{c}\ Ea + \left(\frac{1}{b} - \frac{a^3}{c^2\,(c^2 - a^2)}\right) Eb."$$

The second result, I cannot for the life of me make out, though I have tried lots of times. On page 186, Fig. 48, it seems to me that the direction of the current in the branch $C\ O$, should be from C to O, and not, as in the figure, from O to C, the battery being placed at E. It occurs in the large treatise as in the elementary one. Surely the Editor should have seen that such an important matter as Wheatstone's Bridge should have been correctly represented. He is not reputed to be over merciful towards the blunders of other minor planets. A STUDENT.

MORTALITY FROM CANCER.

[229]—In an article on the "Duration of Life" (KNOWLEDGE, No. XI., p. 228), Mr. Allinson states that diseases of more advanced life, "such as cancer," are increasing in fatality. Is it a fact that cancer is increasing, or is there only an increase in the number of recorded cases, due to a readier diagnosis on the part of medical men? In the Registrar-General's Report for 1879, the total average mortality from cancer is stated at 0·5 per 1,000 of population. If this is correct, my neighbourhood contrasts badly with the country in general. In the south-western suburb of London, in which I live, there have been in my own small circle of acquaintance within the past year five cases of cancer in elderly persons, in four instances abdominal. Can Mr. Allinson point to any trustworthy statistics in support of his statement, which my experience latterly goes far to confirm? It seems to me a question of great interest whether the occurrence of this most frightful disease is influenced by locality. H. A. EVEREST.

RICHTER'S DREAM.

[230]—Richter's beautiful "Dream of the Universe," or "*Traum über das All*," is in the book called "*Der Komet*," vol. 28, p. 129, of the 34 vol. Berlin edition. Loosely translated by De Quincey, vol. 14, p. 134. J. KIRKMAN, M.A.

ARRANGED SQUARES.

[231]—In the Villa Albani, near Rome, opposite the foot of the staircase, as you descend, is a stone tablet let into the wall. On it is engraved the subjoined arrangement of the square of 9, with the quaint Latin inscription, which I have copied and annexed to the square figure:—

15	58	29	34	63	49	74	41	6
7	27	31	81	23	76	80	18	26
38	8	30	71	47	20	21	78	56
73	19	25	42	10	33	50	65	52
22	55	72	1	45	60	28	16	70
79	35	39	66	2	48	17	24	59
14	64	69	12	77	3	51	68	11
46	36	61	53	40	43	4	54	32
75	67	13	9	62	37	44	5	57

"*Quadratus Maximus.*

Lector si doctus admirator; si ignorus scito quadratus hic mathematicé constructus ab uno usque ad octoginta unum 3321 unitates includit quælibet ipsius columnæ tam in lineâ planâ quam in rectâ et transversali unitatis 369 quæ ductæ per norem easdem 3321 unitates restituunt et appellatur maximus quia maximam possidet extensionem. Vale.—Caietanus Gilardonus Romanus philoteohnos inventor A.D. MDCCLXVI."

The inscription is in capital letters, and without punctuation. I am unable to discover any principle of construction in the arrangement of figures, and, therefore, do not see how it admits of unlimited extension. Can you suggest what the principle of construction is?

As regards the squares of even numbers, I have before me the square of 4, 6, and 8, but can discover no principles whatever in them. The square of 4—absurdly called "the *game* of 34," every body knows. The square of 6 stands thus:—

$S = \frac{n}{2}(n^2+1)$
$= 3 \times 37$
$= 111$

1	30	19	18	12	31
32	26	23	20	8	2
33	9	16	22	28	3
4	10	15	21	27	34
35	29	14	17	11	5
6	7	24	13	25	36

The square of 8 stands thus:—

$S = \frac{n}{2}(n^2+1)$
$= 4 \times 65$
$= 260$

1	16	48	33	25	24	56	57
63	55	42	34	26	18	15	7
62	54	19	27	35	43	14	6
5	13	20	28	36	44	53	61
4	12	21	29	37	45	52	60
59	51	22	30	38	46	11	3
58	50	47	39	31	23	10	2
8	9	41	40	32	17	49	64

$S = 2 \times 17$
$= 34.$

I believe these squares may be arranged by placing the diagonal numbers in what I may call their *natural* squares in the first instance, and working up to them; but I have only *succeeded* with the square of 4, as shown by the large and small figures in the annexed square.

1	15	14	**4**
12	**6**	**7**	9
8	**10**	**11**	5
13	3	2	**16**

XUM

In the engraving by Albert Dürer, called "Melencholia I," the square of 4 is represented on the wall of a house, and Mr. W. B. Scott, in his "Life of Albert Dürer" (p. 99), when describing the engraving, calls the squares on the wall "the magic quadrant of numerals of Cornelius Agrippa." This engraving was executed by Albert Dürer probably between 1507 and 1514. So much for "the *new game* of 34," as it has been lately called.—Faithfully yours, E. V. R.

MAGIC SQUARES.

[232]—In my former paper on this subject I gave examples of Bachet's and Poignard's method in squares of odd roots; and I now proceed to give a third rule, and to show how many different arrangements may be made of each square by these methods.

Rule 3, for Odd Squares.

Example of a Square of 5.

Fig. 1.

4	2	1	5	3
2	1	5	3	4
1	5	3	4	2
5	3	4	2	1
3	4	2	1	5

In Fig. 1 place the mean numbers of the series (in this case 3) in the right-hand top-corner cell, and the rest of the numbers in the other cells of the top row in any order at pleasure. Begin the second row with the second number of the first, and so on till the square is filled up.

Fig. 2.

10	0	15	20	5
5	10	0	15	20
20	5	10	0	15
15	20	5	10	0
0	15	20	5	10

Fill up Fig. 2 with the multiples of the root, beginning with 0, by placing the mean number in the left-hand top corner cell, and the others in any order. Then begin the second row with the last number of the first, and so on, and it will be seen that the mean numbers, 3 and 10, occupy the diagonals of the squares in a contrary direction. In Fig. 3 place the sums of the numbers in the corresponding cells of Figs. 1 and 2, and the result is a magic square wherein, in every case, the mean number of the progression occupies the centre square.

Fig. 3.

14	2	16	25	8
7	11	5	18	24
21	10	13	4	17
20	23	9	12	1
3	19	22	6	15

By this method 576 different arrangements can be made of the square of 5. The square of 7 may be varied in the same way 518,400 times, and the square of 9 upwards of 20 million times.

By Poignard's rule the square of 5 may be varied 57,600 times (exactly one hundred times as often as by Rule 3), and the square of 7 no less than 406,485,600 times!—all differing from the results of Rule 3.

And Poignard's squares have another superiority over the others, in the number of ways the total castings of the figures is obtained from them. In Bachet's and the squares by Rule 3 these consist of the addition of each vertical and horizontal band, and of the two diagonals—making twelve readings in the square of 5 and sixteen in the square of 7—Poignard's give eight more readings in the square of 5, and twelve more in the square of 7—as shown in the annexed figure, where, in addition to the sum of 65 being made by the addition of the vertical and horizontal bands, and by the two main diagonals; it is also made by adding each partial diagonals—*a* and the cell or cells on the opposite side *a'*, *c'*, &c., making five cells, and *b* and *b'*, *c* and *c'*: &c., four only are here shown, but four more are found in the partial diagonals at right angles to those marked (twenty readings in all).

	a'	*b'*	*c'*	*d'*	
a'	11	7	23	4	20 *a*
b'	24	5	16	12	8 *b*
c'	17	13	9	25	1 *c*
d'	10	21	2	18	14 *d*
	3	19	15	6	22
		a	*b*	*c*	*d*

But this is not the limit of the number of readings, for Mr. Snart has, by great perseverance and ingenuity, constructed a square of 7 having no less than forty-two readings, which I will send to you.

J. A. MILES.

[233]—As a climax to odd Magic Squares, I send you a square of 49 cells, which was constructed by a Mr. Snart, having some curious properties, not to be found in other squares:—

i			*a*				*b*
	40	39	8	34	9	25	20
	3	12	47	7	45	33	28
	16	42	11	22	10	48	26
h	31	17	15	49 *c*	13	18	32 *d*
	27	41	21	4	14	44	24
	35	19	37	30	46	6	2
	23	5	36	29	38	1	43
g			*f*				*e*

In a Bachet's square of 7 there are sixteen readings of the total 175. In Poignard's there are twenty-eight; but in the above square, by Snart, there are forty-two readings.

14 horizontal and vertical.
2 diagonal.
8 Right angles—*a*, *c*, *d*,—*b*, *c*, *e*, &c.
8 Acute angles—*a*, *c*, *b*,—*b*, *c*, *d*, &c.
8 Obtuse angles—*a*, *c*, *e*,- *b*, *c*, *f*, &c.
1 The centre square and the four corner squares.
1 The centre square and the four squares *a*, *d*, *f*, and *h*.

Total 42

It is seen that the highest number of the progression occupies the centre cell, and is called into operation thirty times.

Fakenham, *Dec.* 30, 1881. J. A. MILES.

VARIABLE MAGIC SQUARE.

[234]—In the arrangements given in KNOWLEDGE of numbers 1 to n_2 *n* is always an odd number, and there is no mention of the following arrangement of the numbers from 1 to 16:—

1	8	11	14
15	10	5	4
6	3	16	9
12	13	2	7

in which 34 is made by the addition, not only of either diagonal or any horizontal or perpendicular line, but also by *every four adjacent figures*, and by the four corner figures, as:—

1	8		10 5
		or	
15	10		3 16

Moreover, these conditions are still fulfilled if I shift the horizontal lines from top to bottom, or *vice versâ*, or the perpendicular lines from right to left, or *vice versâ*. I may, in short, by so moving about the lines, bring any number I choose to any given position in the square. FLORENCE E. BOYCE.

ABSTRACT TERMS IN SCIENCE (*Abstract*).

[235]—Words which are merely abstractions and convenient working terms to the scientist and mathematician are handled in such a way that non-scientific persons are apt to give to the purely abstract conception a concrete meaning.

Take the word Energy. We hear of energy "poured into," "taken from," "transferred," "accumulated," "wasted," and so on. What wonder that many should regard "energy" as something having as substantial an existence as a glass of wine. So with the language used in describing the so-called electric "accumulators" and "storers." Ninety-nine hundredths who read about the Faure accumulators suppose that a real substance called electricity is poured, which can be tapped like beer from a barrel, that a Faure accumulator is as innocent of containing any electricity as the Meteorological Office is of knowing how to make weather forecasts,—it is not a container of, but a producer of, electricity—that it consists of lead plates practically double, back to back, the one side being electro-positive, the other electro-negative; and that it is, in fact, nothing different in the principle of its action, from an ordinary galvanic cell.

There is no need for this foolishly figurative language. The discovery is as wonderful, when described as an improved method of preparing plates for the generation of electricity, as when called, in inflated language, "a method of carrying so many millions of foot-pounds of energy from London to Edinburgh, &c."

EDMUND P. FOY.

PERSONAL IDENTITY *v.* TATTOO MARKS.

[236]—Physiologists admit that the human body is in a constant state of change, fresh materials being added and fresh waste removed, in fact these are the characteristics of every living organism; but that a complete change and reconstitution of the body takes place every seven years will, I am afraid, be admitted by very few. In old age it may take longer than seven years, whilst in disease and in those who live dissipated lives a much shorter period will suffice. Mr. Maguire inquires why it is tattoo marks do not disappear. I will endeavour to answer his query. Tattoo marks are produced by making small punctured wounds into the true skin with sharp needles dipped in some colouring matter. Slight inflammation is produced, but soon passes off, leaving the colouring matter encysted permanently in the substance of the cutis vera and cellular tissue below it. The colouring material used is insoluble as carbon, vermillion thence cannot be taken up by the absorbents or lymphatics and excreted from the body by the excretory glands.

Occasionally tattoo marks do disappear. M. Hutin found that out of seventy-eight persons tattooed with vermilion, the marks disappeared in eleven; and out of 104 tattooed with China ink, not one had become obliterated. The cases where the marks have disappeared have been due to their having been inefficiently performed, and not to the colouring matter having been removed by the lymphatics. This only occurs when soluble and fugitive colours are used, and when the surface of the cutis only is penetrated.

CHAS. BOYCE, M.B.

TELESCOPE.

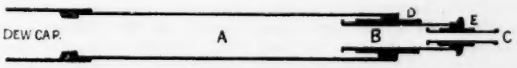
[237]—I am contemplating the expenditure of from £40 to £60 or so in a telescope and accessories. Perhaps some of your numerous correspondents, and notably "A Fellow of the Royal Astronomical Society," would not object to give a little aid in the way of laying out my money to the best advantage. I am an amateur, and that only, and likely so to remain, as my time available for astronomy is very limited. I should, however, like an instrument that would take me well through Webb's "Celestial Objects," and one which would be of real use to me in case at any time hereafter I might have more time to devote to the subject. I am doubtful as to whether a Reflector or Refractor would best suit my purpose. The great objection to the former seems to be that it must almost necessarily be a *fixture*, and this would scarcely suit me at present. Neither is it so handy.

COUNTRY SOLICITOR.

HOW TO CONSTRUCT A TELESCOPE.

[238]—The astronomical papers now running a course in this magazine have, no doubt, induced many readers to begin a telescopic scrutiny of the skies. Pecuniary considerations, however, may have affected the number of astronomical recruits, and, therefore, I think it not uncalled for to show how one may become possessed of a good three-inch telescope at a comparatively trifling cost. In the beginning of last year I succeeded in making an effective telescope of that size, and where I have succeeded very few need fear failure. Its cost was inconsiderable, and I shall be glad if the following short account of its construction encourages anyone to make a similar attempt.

Having ascertained the dimensions of a 3 in. telescope, I got a carpenter to make several cylindric moulds, the largest being 34 in. in length and 3½ in diameter; and upon this mould I made the principal tube, employing in its construction nothing but the stoutest and largest-sized cartridge paper and an unlimited supply of thick flour paste. The method was as follows:—As much of the first sheet as formed the internal circumference of the tube was painted dead black, and wound, not too tightly, round the mould, the second layer being formed by the continuous winding of the first sheet. No paste was used for the second layer, in order that the inside of the tube might not be blistered, a slight touch of paste being given where the sheet overlapped and ended. Then two sheets at a time were wound round as evenly as possible, paste being laid on with a liberal hand, and each layer allowed to dry thoroughly before winding on its successor. This process was continued until a thickness of over one-eighth of an inch was reached; and when removed from the mould, and carefully evened at the ends, I had a light tube, 29 inches in length, and as hard and smooth as the tube of a 3-inch telescope need be. It is astonishing how hard pasteboard can be made when good paper and plenty of paste are used. (I may mention, as a warning, that the removal of the tube from the mould was somewhat difficult, as the contraction of the paper has been greater than allowed for.) The other tubes, of which details are given below, were made in the same way, and of nearly the same thickness. The method of fitting the pieces together will be readily understood from the following longitudinal section of the instrument:—



It will be seen that the telescope has two "draws," B and C, which slide in fixed tubes, D and E. Round the middle of the fixed tubes strips of paper 2 inches in width for tube D, and 1 inch for tube E, are firmly pasted, forming bands of sufficient diameter to fit the tubes into the ends of which they are fixed. The fixed tubes are thus tightly fitted, and are held in their places by small brass screws. The second draw, C, is a short tube, whose diameter is just sufficient to admit the tube of the eye-piece. The draws are fitted with stops, and the order in which the various pieces have been placed together is obvious. Each part was allowed to dry and contract thoroughly before being fitted. A brass screw is fitted into the mouth of the tube, and receives the screw attached to the cell of the object-glass. I may mention that, for the sake of appearance, the telescope is covered with dark-coloured imitation morocco. The dimensions are as follows:—Tube A, length 29 inches; internal diameter, 3¼ inches. B, 10 and 2⅞ inches. C, 5½ and 1¼ inches. Fixed tube D, length 6 inches, projecting 2 inches beyond end of tube A. Fixed tube E, 6 inches, projecting 1 inch. Focal length, over 41 inches; closed, under 34 inches.

When the various tubes, &c., were completed, glasses of first-rate quality were purchased, and the whole parts put together and carefully adjusted. There is little or no vibration.

The mounting of the telescope was a simple matter. For out-door work a tripod garden stand and cradle was purchased, and for work indoors a pillar and claw-table was seized, the top removed, and, with a little trouble, fitted so as to receive the cradle of the garden stand, and the claws loaded with lead, for the sake of steadiness. Including the extra expense caused by bungling and ignorance, the total cost of the instrument was about £12. The table stand, it must be remembered, however, cost only a remonstrance.

I need hardly say that in the course of its construction I enjoyed many distinguished failures; parts were made and remade, fitted and re-fitted before all defects were rectified and the instrument entitled to rank as a telescope. Its appearance may not be smart, but a telescope is handsome according to its performance.

A. P. M.

COLOURS OF STAMENS.—ORIGIN OF EVERGREENS.

[239]—Mr. T. Dowse's objection [214] to my theory that flowers were all originally yellow, has already been advanced in a private letter by Mr. Darwin (who, I am glad to say, is inclined to agree with my general view that petals are derived from flattened stamens). Still, I feel disposed, in spite of such an authoritative critic, to adhere to my first statement. It is true the filaments of many stamens are white, pink, or purplish; but this is the case chiefly (so far as I have observed) with very highly developed flowers, in which the petals have undergone much change of colour. It is especially noticeable in tubular blossoms. On the other hand, most very simple flowers, such as buttercups, have bright yellow filaments, and my general impression has been that petalless flowers (for example, catkins) usually have yellowish stamens. The point is an important one, and I will make definite observations

XUM

upon it during next season. Conservatory flowers are the worst possible test in such a case, because they are especially chosen for their highly-developed petals; and yet eleven instances examined by Mr. Dowse out of twenty-three, even there had yellow filaments, while only seven had white, and five red.

In answer to "Plesiosaurus" [182], should say that evergreens never had any origin. The real problem is exactly the reverse—the origin of deciduous trees. Clearly any plant is benefited by having its leaves at work all the year round; and all plants were evergreens till a comparatively late geological period, when the poles began to grow cold. A few trees then acquired the habit of deciduousness, in adaptation to the new conditions, but to this day, in the tropics, evergreens are universal. The process by which deciduous leaves were developed I have already attempted to explain in my little book, "Vignettes from Nature," and I will not attempt to give the explanation over again here. GRANT ALLEN.

INFLUENCE OF SEX ON MIND.

[240]—Under the above heading, "J. McGrigor Allan" makes the following assertion—"Women lack the highest quality of the human mind—justice." If this be true, how is it that Shakespeare and Sir Walter Scott, to say nothing of lesser men, have left so widely different a testimony respecting the dignity of woman. To quote the words of one of the most polished writers of the present day, "Shakespeare represents women as infallibly faithful and wise counsellors, incorruptibly *just* and pure examples, strong always to sanctify, even when they cannot save." In Sir Walter Scott's imaginations of women, we find (with endless varieties of grace, tenderness, and intellectual power) a quite infallible sense of dignity and *justice*. Are these immortal writers wrong, and J. McGrigor Allan right, or *vice versâ*? Will you or any of your readers answer this question, and oblige one who is— ONLY A WOMAN.

WINDMILL ILLUSION.

[241]—The Windmill Illusion, p. 233, reminds me of two somewhat similar illusions I have noticed:—1. The "governors" of a steam-engine appear to rotate either way you please; 2. The same with the "parallel rods" of a locomotive when seen from a railway-carriage near the engine.

Perhaps "Enquirer," Query 166, p. 234, may be glad to know of the Dot and Dash system of shorthand, invented by T. S. Noble, which is considered by some to be more easily learnt than Pitman's. VEGA.

VOLCANIC PROJECTILES.

[242]—In the article on Vulcanology, pp. 129 and 130, it is stated that Vesuvius sometimes exerts such force as to project matter nearly four miles high; and, further on, it says astronomy has taught us that the world is not, as was long believed, a liquid mass surrounded by a thin solid shell.

Now, with regard to the first statement, will you, sir, kindly say if there is any foundation or belief that this force and height has ever upon exceptional occasions been greatly exceeded, and, if so, whether you think it possible that such matter might be thrown beyond the direct power of the earth's attraction, to return, perhaps, at some future time in the shape of meteoric stones, or never; also what height would be necessary for such matter to attain to get beyond this attraction.

With regard to the second statement, how does astronomy prove that the earth is solid throughout? JOHN ROUSE.

POPULAR FALLACIES.

[243]—You would indeed deserve the thanks of all sane peoples if you could reason away fallacies as suggested (No. 203, page 233), even if they only concern the familiar poker that does *not* "draw up" the fire.

In some parts of Scotland nervous people think that to praise their possessions will necessarily bring destruction upon the thing praised. A man says his horse has never been ailing for a day, or that he loves a favourite tree, or admires his wife's dress. He has sinned in uttering his thought, but if he raps three times on the table and says "I must not *forespeak* myself," perhaps his horse will not go lame, his tree will not be blown down, his wife's dress will not be torn.

It would be impossible to talk gravely of such a custom were it not for the repeated surprise with which one observes that educated (*and religious!*) people still have a lurking belief in its efficacy, just as they still have a lurking dislike to thirteen at a dinner table.

M. McC.

ANIMAL PHYSIOLOGY (THE EYE.)

[244]—In the adjustment of sight, found in the vision of birds, the eye is peculiarly adapted for long and short sight. It is like a cup in shape, has bony substance in the form of plates, extending along the top and bottom of the eye, forming a support of the sclerotic or hard lining, stretching from the cornea to the back part of the eye, along which the retina is spread. These plates contract or distend at will, but when contracted, they press the humour, causing the cornea to protrude, and the retina to recede from the lens. Connected with this pressure, and alteration of humour, there is a peculiarity in the eye of the bird—a thing like the appearance of a feather, which enters the vitreous humour by the optic nerve, commonly called a pecten, from its likeness to a comb; containing a lot of blood-vessels, mixed with pigment granules. The question is, what effect has this upon the eye? Whether it is subject to erection or distention on being filled or deprived of blood, or does this pecten act as a sieve, passing through it matter from the blood to feed the vitreous humor; or is it used in passing off what surplus humor there may be, and forming it into blood? If so, in what manner does it affect the vision? Something of the same kind is found in fish, although situated differently, it being between the two layers of choroid, instead of entering into the vitreous humor, as in the case of birds. In an animal belonging to the highest class of mollusca, there is a thin retina at the back of the eye, and at the back of this a choroid, while at the back of this again, is another retina, apparently for some other purpose than to receive impressions. Is there any similarity between this and the pecten of the bird, and what purpose do they perform? GEORGE BROWN.

SOLAR PUZZLE.

[245].—There could be nothing between the sunlight and the window-blind, except such things as those you suggest; but you must admit that not one of them could obscure, in regular and very slow succession, about three minutes to each hole, and in a diagonal direction, the sun-patches, and, be it remembered, without interfering in the least with the long horizontal patch of sunlight, or with the two or three holes on the extreme right. Forgive me for my pertinacity. I see the difficulty in arriving at any solution, and that was why I wrote to KNOWLEDGE. One solution occurred to me; it was—could an insect have obscured the holes? Possibly, but then it could only have been one at a time, for to have three, or even two of the holes obscured at once would have required an "animal." I can't say an "insect," six inches long, at the least. A. T. C.

A NEW FACT IN PRISMATIC ANALYSIS.

[246]—With reference to the "Answers to a Correspondent" in KNOWLEDGE, vol. 1, page 257, about the delay in furnishing more "Blowpipe Lessons," I would reply that I have now sent four communications to KNOWLEDGE, only one of which, apparently, has been considered up to the publishing mark.

It has just struck me that the Editor's complaint against too many of us is prolixity. However, it is refreshing to see, by the Editor's remark above-mentioned, that, in Bow-street language, "I am wanted"; and so I have the pleasure to enclose another "easy lesson," with what may be termed a "telegraphic summary" of a curious result, obtainable by anyone possessing a lens and a glass prism on a sunshiny day:—

Focus	sunbeam	admitted	Venetian blind	on
face	prism	: instead	of | spectrum	green
beam	within	prism	: why | green?	

Hoping our "no-rent" friends across St. George's Channel will admit this "bangs Ballagher" (*i.e.* Dr. F. G——e) in scientific conciseness.—I remain, &c., W. A. ROSS.

WEATHER FORECASTS (ABSTRACT).

[247]—I use the forecast chart and remarks, in conjunction with observations of the general aspects of the weather and sky around me. The value of forecasts thus applied, which I hold to be the true and rational method, is, on the whole, satisfactory. "Bad shots" are exceptional. It is well known that persons constantly out of doors—seamen, farmers, millers (wind), &c.—become highly sensitive to atmospheric changes, and are able to judge fairly well of impending weather. Knowledge of this kind is only gained by long observation, and cannot be communicated.

Storm warnings are, as a matter of fact, of most use to seafaring people; crops must risk the weather, favourable or unfavourable to their growth. Weather-wisdom in harvesting is a great help in securing crops in sound condition.

XUM

Of late the *New York Herald* has made some remarkable "hits." The stormy character of the past three months would permit them to risk almost anything resembling a "weather-case" with a fair chance of success. Nevertheless, they make some "very bad shots," and if they venture to add more to the simple announcement of a storm, such as "developing energy," "snow in the North," "attended by electrical phenomena," &c., it betrays an attempt on the part of the "prophet" to obtain credit for an amount of sagacity he does not possess. I shall not dwell upon the sweeping character of these warnings generally, but draw the attention of Mr. Spiller and A Fellow of the Royal Astronomical Society to the circumstance that up to the present time the Americans have not attempted to foretell fine harvest weather, or settled weather of any kind, which, if done, would cause me to view their weather predicting more favourably.—Yours, &c., ALFRED DONBAVAND.

COMMUNICATION WITH THE MOON.

[248]—The following excerpt from the *Edinburgh New Philosophical Journal* for October, 1826, may interest "X. Davine," (letter 206, p. 233). As the Editor has remarked, the idea is due to a German, not a Frenchman.

"Gruithuisen, in a conversation with the great astronomer Gauss, after describing the regular figures he had discovered in the moon, spoke of the possibility of a correspondence with the inhabitants of the moon. He brought, he says, to Gauss's recollection, the idea he had communicated many years ago to Zimmerman. Gauss answered, that the plan of erecting a geometrical figure on the plains of Siberia corresponded with his opinion, because, according to his view, a correspondence with the inhabitants of the moon could only be begun by means of such mathematical contemplations, and ideas which we and they must have in common."

Gruithuisen was one of the most painstaking and keen-visioned selenographers who ever lived, though the exuberance of his fancy frequently led him astray. The work done by him in the earlier part of the present century is something marvellous, considering the comparatively small instruments he employed. Many of his drawings, &c., have been recently published for the first time in the German periodical *Sirius*, and are worthy of careful study.—H. SADLER.

A NEW COMPARISON OF POISONS.

[249]—"S. E. P.'s" (No. 172, p. 208) criticism of my letter is somewhat hieroglyphical, and at first rather puzzling. He says the allegation is, that li. ce. is three times as poisonous as ba. ce. I am curious to know what li. ce. and ba. ce. mean.

"S. E. P." continues that li. ce. has 20 per cent. of metal, where the citrate has probably much less than 7 per cent.; so li. ce. cannot be his formula for lithium citrate (Li_3, C_6, H_3, O_7 10% Li), nor yet for lithium chloride (Li Cl), which contains 16·4 per cent. of metal.

That some metals may be very poisonous in one form of combination, and not in another is very true, but it depends upon the properties of the substance employed for combination.

I think if anyone has mystified M. Richet's plain proposition it is "S. E. P.," for lithium as a metal is non-poisonous.—I am, Sir,

TECHNICAL CHEMIST.

ANIMAL *versus* VEGETABLE FOOD.

[250]—If the following be worthy of a place in your pages, I shall be glad if you will insert it, for it has struck me that in the arguments that have been brought forward in KNOWLEDGE on this subject, and those used by vegetarians generally in favour of their system, one thing has been lost sight of, or disregarded—viz., the provision and requirements of nature.

If we go to the frigid zone, we find that practically vegetable food is out of the question, for the simple reason that it cannot grow in those sterile regions, amongst the snow and ice. The inhabitants are therefore obliged to eat that which is provided in abundance—viz., animal food.

We are told that the effect of the extreme dry cold to which the inhabitants are exposed, is to produce a desire for the most stimulating food that they can obtain; that in such a climate bread is not only not desired, but is comparatively impotent as an article of diet; that pure animal food, the fatter the better, is the only sustenance which maintains the tone of the system, and supplies the degree of muscular energy necessary for the particular wants of the locality.

But if we turn our thoughts to the torrid zone, the state of things is entirely reversed. There, the general use of animal food would be exceedingly difficult; for, as your readers will doubtless be aware, in a hot climate, animals, if not cooked immediately they are killed, become tainted and unfit for food; therefore, it can only be used on special occasions, and vegetable food is, to all intents and purposes, the only food in hot climates.

Also in the tropical regions of the globe, where the fertility and productiveness of the soil are so largely increased by the high temperature, less labour suffices for the raising of food; less labour is also required to provide habitation and raiment; less demand, therefore, is made upon muscular energy, and, consequently, less or no animal food is required to keep it up.

If we take into consideration personal taste, we find that, on a hot summer's day, nine persons out of ten would prefer a dish of cold, stewed fruit with rice, to a joint of hot, cooked meat; and in the winter it would be just the reverse.

It seems to me, then, the conclusion to be drawn from the above facts *is that as we* (to bring the matter home), live in a temperate latitude, between the two extremes, where a moderate amount of musaular energy is required to provide food, clothing, and shelter, our diet should consist of both animal and vegetable, with a predominance of the former in winter, and of the latter in summer.

C. E. H.

P.S.—Does the trichina exist in bacon, or only in pork in its uncured state?

TOADS.

[251]—On p. 202 of No. 10, for Jan. 6, 1882, appears a paragraph on the vitality of toads, in which it is said that M. Legrips asserts that toads are inoffensive.

In Professor du Boiz-Reymond's lectures on "Physiology," which I had the pleasure to hear last summer in Berlin, he distinctly stated that toads were poisonous, and that they ejected the poison when molested. If the poison reached the face, striking, for example, the eye, it would be dangerous certainly to the eyesight; if not more. He declared that they have poison enough to kill a small bird; and that even when experimenting with the common frog, he had learned through painful experience to keep his eyes shut when seizing them; for on more than one occasion they had spurted out poison which caused pain enough on striking his eye to make one keep to the sofa for the afternoon, as he expressed it.

If you would, through your appreciated paper, throw some light on this contradiction, you would much oblige yours, &c.,

D. R. McC.

SUNLIGHT ON FIRE.

[252]—With regard to my query, "Effect of Sunlight on Fires" (136), I am much obliged to "C. T. B." for his reply, giving, as it does, I think, a right explanation of what I called attention to. I would remind "Paugul" that contradiction is not explanation, and that no good is gained by telling querists that the evidence they quote is useless, and that their suppositions are absurd. As a matter of fact, nine people out of ten that I have asked tell me that they think that bright sunlight does interfere with the burning of an ordinary house fire, and that a cigar, unless continually puffed, will go out much sooner if the sun is shining on it, than otherwise. I enclosed a query with 136 concerning the nature of noises made by trains, but apparently it was not worth insertion.

N.

DARWINISM AND THE MICROSCOPE.

[253]—I beg to offer a few observations upon Darwinism, although drawn from a new source. The microscopic examination of the blood corpuscles belonging to different classes of the vertebrata.

Now it is well known that these discs vary greatly in form, size, and structure, not only in those classes themselves, but even in the different species of the same class. Thus in birds, reptiles, and fishes, they are, as Dr. Carpenter in his "Animal Physiology" observes, "much larger than in the Mammalia, their form is oval instead of round, and instead of being depressed in the centre, they bulge out on each side." In man, for example, their diameter is, according to him, 1-3200 of an inch, and in other mammals it varies from 1-4000 to 1-5000 of an inch, although in the musk deer (*Moschus javanicus*), it is only about 1-12000 of an inch. In birds their long diameter is from 1-700 to 1-2400 of an inch; in reptiles from 1-1000 to 1-1800 of an inch; and in fishes the long diameter of the blood discs is about 1-1900 to 1-2000 of an inch." It is remarkable too that the smallest British mammal, the harvest-mouse has as large corpuscles as those of the horse, and that in the common mouse they are even larger than in the horse or ox."*

* "Henfrey's Micrographic Dictionary."

XUM

The red corpuscles of the blood are, moreover, highly-important organisms, inasmuch as they are presumed to be the carriers of oxygen from the respiratory organs to every structure and tissue of the animals in which they are found. Seeing, then, that their function is so essential, and that they differ so widely in size and form throughout the Vertebrata, are we not justified in asking how, if Darwinism is true, the fishes, reptiles, birds, and mammals, could have been derived successively from "one common ancestor," according to Mr. Donbavand's definition? In other words, how could differences so necessary, as far as we can judge, to the very existence of these separate classes, have been brought about by any either internal or external influences? For instance, by what unseen agency, or by what special "environment," were the very large corpuscles in the Reptilia changed into the minute circular blood discs in the Mammalia?

It is also an admitted fact, that the capillaries or terminal blood-vessels are, in every animal, formed in strict relation to the size of its blood-corpuscles, so that the blood of one animal cannot support the life of another whose blood-discs differ in size from its own. We have, then, to ask the defenders of Darwinism to account, not only for these specific differences in the blood-corpuscles themselves, but also in the capillaries through which they circulate? W. H. O.

SUNGOD FESTIVALS.

[254].—It having been pointed out to me that in the number of your excellent journal for Dec. 30th there had appeared an extract from an article in the *Times*, entitled "Babylonian Sun-worship," I beg to take the opportunity thus offered of saying a few words thereon. When I first heard of the appearance of this article in the *Times*, it was then too late to point out its inaccuracy in that journal, and a letter, sent to one of the leading periodicals, was not inserted. I had hoped, however, that it would have gone no further, but as the most innacurate portion has been given again in your journal (which, I am glad to see, has already a very wide circulation), I have thought it well to warn the public, who cannot judge for themselves, against such newspaper articles.

However surprising it may seem, it is nevertheless true, that the word translated by the *Times*' correspondent as "festival," does not mean anything of the kind. It is the usual word for "clothing," or "investment," and in the text from which this translation was made it is stated that these clothes or vestments were "the gift of the king." It will easily be seen that this correction changes at once the whole bearing of the passage, for though it is not impossible that the dates upon which these gifts were made were festivals, yet, as there is no statement to that effect, they are of but little use in determining the times of the festivals of the Sungod in Sipara. Of course, the rendering of the other words in the lines translated (excepting the dates) are in every case mere guesses.—I am yours, &c. THOS. G. PINCHES.

Queries.

[195]—QUICKSILVER, NON-POISONOUS.—I am able to give rather a curious instance of the non-poisonous effects of mercury in the form of quicksilver. Having always been informed that quicksilver would be poisonous if swallowed, I was rather struck with the following:—In a "lab" where I was studying some years ago, a young lad employed there told me that he swallowed quicksilver without feeling any the worse for so doing. From what I had previously heard, I did not believe him. He took some out of the Hg. bottle and swallowed it! Thinking that if he had really swallowed it he had taken a large enough dose, I waited until the next day, when I myself put some in his mouth which he swallowed! Could S. E. P. tell me if the mercury would pass through the system unaltered, also if it would be safe for any one to try the experiment on himself?—F.C.S.

[196].—CHEMICAL HEATING APPARATUS.—Where can I find an account of such an apparatus for rooms? Has any method of cooking by chemical heat yet been discovered and applied?—J. H. B.

[197].—REFRIGERATOR.—Where can I find an account of the most improved refrigerator for ships—such a one as enabled salmon to be recently brought from Hudson's Bay (I think)?—J. H. B.

[198].—TRICHNLÆ.—Does the operation of curing destroy the trichinæ which may happen to infest the green hams or sides?—J. H. B.

[199]—TOBACCO AND SCIENCE.—When a smoking-pipe is placed with the stem vertical and the bowl uppermost, the smoke issues downwards from the mouthpiece and then immediately ascends. When it is inverted, so as to have the mouthpiece uppermost, no smoke issues therefrom. Why is this?—P. J. GRALL.

[200]—LEASES.—Can you inform me through KNOWLEDGE how to determine the value of leases?—JAMES GREGG. [The conditions must be specified.—ED.]

[201]—COLOUR-HEARING.—Will be glad if anyone can refer me to any books or magazine articles giving information as to Bernstein's researches into the phenomenon of colour-hearing.—B. J.

[202]—GRAVITY.—Required the distance from the earth's centre at which the earth's attraction is balanced by that of the moon when at her mean distance. [If moon's centre be at distance d from earth's, and x the required distance, we have

$$\frac{\text{earth's mass}}{x^2} = \frac{\text{moon's mass}}{(d-x)^2}, \text{ or } \frac{d-x}{x} = \sqrt{\frac{1}{81}} = \frac{1}{9}; \text{ whence } x = \frac{9d}{10}$$

ED.]

[203]—SATELLITES—URANUS'S AND JUPITER'S MOONS.—Will yoube kind enough to tell me how many moons of Uranus have been discovered, and what are the names of Jupiter's and Uranus's moon's?—C. W. JEWITT. [Uranus and Jupiter have each four known moons. Those of Uranus have been called Ariel, Umbriel, Titania, and Oberon (do not know why). Those of Jupiter were called the Medicean stars, and by other names; also Io, Europa, Ganymede, and Callisto. They are always called by astronomers by the impressive names, I., II., III., and IV.—ED.]

[204]—ALGOL.—I should feel obliged for a list of the minima (those occurring in the night hours would suffice) of this variable star for the present season.—L.

[205]—OBSERVATION WEATHER.—I have read the remarks upon favourable nights for telescopic observation, both in the Editor's "Half-hours with the Telescope," and Webb's "Celestial Objects," but am anxious to find out whether any more definite laws are known on the subject, as, for instance, whether barometrical pressure or change makes any difference?—a wind or calm seems to have little to do with it.—L.

[206]—OPIUM.—Will some reader, "up in medicine," kindly inform me why opium, a powerful stringent, should in the case of lead-poisoning act as a purgative?—YOUNG PILL-BOX.

[207]—HEAT.—Will you kindly, through your columns, let me know whether there is any truth in the statement that a man may plunge his hand into molten iron with impunity? Has this anything to do with the spheroidal state?—PERCY V. DODD.

[208]—COMPOUND PENDULUM.—Will you kindly refer me to the best work for a description of a "compound pendulum," and the beautiful figures obtained by its aid? Would it be too unscientific to deal with in KNOWLEDGE?—JAS. A. GEE.

[209]—SATELLITES OF URANUS.—Please say whether any, and if so what, theory has been advanced in order to account for the retrograde motion of the satellites of Uranus. I believe the axis upon which that planet revolves lies in a plane nearly coincident with that of his orbit, and presume that the orbits of the said satellites are about at right-angles thereto, also that the rotatory motion of the planet itself accords with that of the satellites. Are these things so?—W. A. M. D.—[Very little is known about the axial rotation of Uranus. It is generally supposed to be as W. A. states. The satellites certainly move so.—ED.]

[210]—HOMER'S ILIAD.—Could you or any of the readers of KNOWLEDGE inform me of the name, price, and publisher of any volume containing a *prose* account of Homer's "Iliad," "Labours of Hercules," "Jason's Expedition," &c.?—W. GIBSON.

[211]—PYSCHOLOGY.—Can you recommend me a good Catholic work on Pyschology written in English, or a translation into English, and of moderate price, that is, not exceeding twelve or fifteen shillings?

[212]—What is the 12th (last) axiom of the First Book of Euclid? It is given differently in different books.—URSA.—[Euclid's 12th axiom is a veritable crux, and another is often substituted. It ran, "If a straight line falling on two other straight lines make the adjacent angles on the same side together less than two right angles, these two straight lines being produced, will at length meet on that side on which are the angles which are less than the right-angles.—ED.]

[213]—ORGANIC COMPOUNDS.—In Mr. W. Mattieu Williams's article in No. 3 of KNOWLEDGE, it is said that "many organic compounds have been made in the laboratory from mineral materials." Will you kindly inform me if such have been made from non-vegetable materials? I know that madder has been made from coal-tar, but then coal-tar is a vegetable material, and in this

instance, therefore, the vegetable laboratory has been at work before that of the chemist.—SIQUIS.

[214]—VOLTAIC ELECTRICITY.—Is any elementary treatise (with experiments) on voltaic electricity, similar in style to Tyndall's "Lessons on" (frictional) "Electricity" published?—REYNELL W. HAY.

[215]—BOOK ON BLOWPIPE ANALYSIS.—Can you recommend me a good practicable work on blowpipe analysis?—F. GRAHAM FAIRBANK, C.E.

[216]—WORKS ON BOTANY.—Would you acquaint me with the latest work on systematic botany, or is there a later edition of Bentham's Botany than 1866?—E. A. SNELL, M.B. (London).

[217]—PALÆOBOTANY.—(1.) Where can I find *Heterangium* and *Katoxylon* figured and described? (2.) Is it difficult to obtain *Sipillaria* (internal)? Any information will oblige.—F. R. M. S.

[218]—TENNYSON.—Please explain the lines:—

. . . . "Look yeu, there is a star
That dances in it (the comet)."
"Harold," Act I. Sc. 1.

. . . "and over those ethereal eyes
The bar of Michael Angelo."
"In Memoriam," Canto 87.

. . . "the sea-blue bird of March."
Ibid, Canto 91.

May I venture to endorse the sentiments in the Laureate's lines:—

"Who loves not Knowledge?
. . . . . May (it) mix
With men and prosper!
. . . Let (its) work prevail."
"In Memoriam," Canto 114.

—RUEVERTE.

Replies to Queries.

[84]—ANCIENT MAN.—Might not the depth at which the "pieces of burnt brick and pottery," &c., were found, viz., 60 ft., be partly explained by the action of worms, according to the researches of Darwin, as recorded in his latest work? This would diminish the estimated antiquity.—E. A. SNELL, M.B. (Lond.)

[130]—LANGUAGES OF THE EARTH.—The languages of the earth are estimated at 3,064, of which

587	are spoken	in	Europe.
937	,,	,,	Asia.
276	,,	,,	Africa.
1,264	,,	,,	America and Australia.
3,064			

—Yours faithfully, JNO. HOLMES.

[146]—The following is the result of experiments with substances injected into the jugular vein of a rabbit, the urine being collected and afterwards examined:—Maltose is partly converted in the blood into grape-sugar, and partly passes out unchanged. Soluble starch yields dextrin and grape-sugar. Achroodextrin (α) suffers only partial change, grape-sugar and maltose being found in urine, together with dextrin. Achroodextrin (β) yields a similar result. Achroodextrin (γ) yielded no sugar. We may conclude, as a rule, that the changes starch undergoes in the body are similar to those it undergoes when under the action of diastase. Diastase has this effect on starch—viz., that starch, submitted to its action, yields soluble starch, maltose, grape-sugar, and three forms of dextrin, α, β, and γ achroodextrine respectively. The term "achroodextrin" means a dextrin not coloured by Iodine.—F.C.S.

[153]—DOUBTFUL ORGANISMS.—The many attempts to define the line of demarcation between plants and animals have all broken down one after another, and modern definitions have no chance of a better fate. Hence Haeckel's group of intermediate forms, which, however, is not followed by most English biologists. Hooker, Cooke, and other botanists regard the *Myxomycetes* as vegetable fungi. A newer and probably better view is that of Mr. Saville Kent, who insists on their animal nature as closely intermediate between certain types of Infusoria and Sponges. The *Mycetozoa*, as he calls them, comprise several genera, as Æthalium, Stemonitis, Prichia, Arcyria, Lycogala, Didymium, Reticulariæ, &c. The subject is one of great difficulty and much interest.—ECLECTICUS.

[155]—TORTOISES.—There is a large tortoise now in Ceylon (at east, I have not heard of its death since I was there four years ago) which was brought to the island by one of the last Dutch Governors consequently about eighty years before. It came, I think, from Java, and its age was then unknown, but it was supposed to be even at that time of very great age. I knew it for over twenty years. There was, I believe, an account, with illustrations, of this tortoise, either in the *Graphic* or *Illustrated London News* at the time of the Prince of Wales' visit to Ceylon. A turtle was taken on the coast of Ceylon some years since which had on one of its flappers a ring, which, by the date on it, was placed there some thirty years before. —B.M., F.R.C.S.

[177]—THE NAUTILUS.—"M. Webb" asks the use of the *siphuncle*, or tube running through the *septa*, or partitions of the shell of the pearly nautilus. This tube is believed by some to have the function of maintaining a low vitality between the disused chambers of the shell. Others say that it is used to alter the specific gravity of the animal, and that by receiving or expelling fluid from or to the body, in which it terminates, the nautilus is enabled to sink or to swim in the sea. The exact functions of the siphuncle are, I believe, still unknown.—ANDREW WILSON.

[165]—HORSERADISH.—This herb, I believe, possesses merely astringent and stomachic properties. Its use as an adjunct to food corresponds with that of mustard, and it may, therefore, assist in stimulating the flow of gastric juice.—ANDREW WILSON.

[169]—LIGHT AND LANTERN.—1. Tyndall's "Six Lectures on Light," delivered in America (Longmans, London, 1875). 2. "Light," by Mayer & Barnard (Appleton & Co., New York, 1878). 3. "Art of Projecting," by Professor Dolbear (Dillingham, New York, 1877). 4. "Optics for the Lantern," by Lewis Wright (Macmillan, London, 1882).—THOS. S. BAZLEY.

[180]—THE POLE.—The reply given to the question, "How Arctic explorers could tell exactly when they reach the pole?" (p. 234), can only apply to the (nearly) six months that the sun is invisible at the pole, for during the remaining half of the year, the constant sunlight would prevent any astronomical observations of a *star* being taken, as no stars could be seen. If the pole is ever reached, it is likely to be during the time of sunlight there, and it is, therefore, by observations of the sun's altitude at different positions round the heavens—correcting such altitudes for changes of the sun's declination during the intervals of observation—that the explorer will be able to tell, with very considerable accuracy, when he has arrived at the extreme north of the world.—J. RAE. [That is one method among many; but, after all, determining when the pole is reached is really determining the latitude. At any time, the latitude can be determined by taking the sun's apparent altitude at noon. If this, corrected for refraction, &c., $= A$, and sun's declination (north position) at the time $= \delta$, then the latitude, λ, is given by the formula—

$$\lambda = 90° - (A - \delta)$$

At the pole, where the latitude = 90, we have—

$$A = \delta$$

So that if the sun's observed noon altitude, corrected, is equal to his known northerly declination, the observer is at the pole.—ED.]

[182]—EVERGREENS.—I believe the origin of the "evergreen" condition in plants is traceable to the general principles which regulate "natural selection." If we suppose that any plant during its spring and summer life acquired gradually an extension of its period of active nutrition, along with a fixation, so to speak, of the products of nutrition in the leaves (chlorophyll, &c.), the origin of the evergreen state is not difficult to conceive. We find an analagous case in the storage of starch as reserve-material in bulbs and tubers. Such a food-supply enables a plant (like a person with a deposit-receipt at his bank) to flower earlier than its neighbours, and there is no difficulty in conceiving that this habit of storing food may have grown and intensified by slow degrees.—ANDREW WILSON.

[184]—ALMANACS AND CELESTIAL MAPS.—Middleton's Atlas is published by Whitaker & Co., Paternoster-row; Gall's (only a shilling), by Gall & Inglis, 25, Paternoster-square. Both are superseded by Proctor's "Half-Hours with the Stars" and "Library Atlas."—THOS. S. BAZLEY.

[188]—OPTICAL ILLUSION.—This is very antique; it is the *shadow* of the pin which is thrown on the retina, and not being inverted, is paradoxically seen upside down.—S. J.

ELECTRIC CLOCKS.—A system of electric clocks has been organised for Genoa, and is now being carried into execution. The clocks will be arranged in five distinct lines, all branching out from the Municipal Palace. The first will extend to the Porta Lanterna; the second to the Molo Vecchio; the third to the Carignano; the fourth to the Palazzo Tommaseo; and the fifth to the Piazza Manin.

XUM

Answers to Correspondents.

*** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—*1. No questions asking for scientific information can be answered through the post. 2. Letters sent to the Editor for correspondents cannot be forwarded; nor can the names or addresses of correspondents be given in answer to private inquiries. 3. No queries or replies savouring of the nature of advertisements can be inserted. 4. Letters, queries, and replies are inserted, unless contrary to Rule 3, free of charge. 5. Correspondents should write on one side only of the paper, and put drawings on a separate leaf. 6. Each letter, query, or reply should have a title, and in replying to letters or queries, reference should be made to the number of letter or query, the page on which it appears, and its title.*

ARCH. P. MEIKLE. Many thanks; your letter useful.—MEMB. SOC. BIBL. ARCH. All your communications interesting.—J. A. MOWATT. Thanks.—PHINEAS FOGG. Our classification seems to need no explanation. As you say, we have Correspondence Columns, Queries, Replies, and Answers to Correspondents; ought it to be necessary to explain that we receive some letters we like to publish as such, many queries, not a few replies, and a number of letters, which, though not suitable for publication, require answering? The difficulty is to classify letters, &c., at all, we receive so many more than we can deal with properly. We may soon have to open a new section for the names only of correspondents. The title, "genre painters," is applied to painters who take for their subjects scenes of ordinary life in some special line. (2.) The name "Millais," is ordinarily pronounced "Millay." (3.) Dionysos, or Dionysus, is the Greek equivalent for Bacchus, as Aphrodite for Venus, Pallas Athene for Minerva. (4.) Do not know who made the Pears' soap "Dirty Boy." You see, perhaps, why some questions are dealt with here, instead of under the head "Queries."—W. C. The Star Maps are intended to be used by persons who, having looked at the maps *otherwise* than "in the dark," had observed that such and such constellations were to be looked for towards the south, east, west, north, and so forth. I do not think their use would be very great to anyone who took them out in the dark, and tried to decipher them without a light.—W. RIDD, C. E. ROBERTS, W. G. BELL, R. W. J., R. C. AULD, and others. It would be well if correspondents would kindly remember that remittances and business communications generally, must be sent to the publishers, not to the editor. All letters received after Saturday lie over, and are not even opened till the ensuing Friday or Saturday. If they contain stamps or P.O.O., with orders for KNOWLEDGE, there is naturally a week's dissatisfaction, through whose fault would you say?—R. W. J. thinks it is very good of us "in our old age, to give to the world at a price which is equivalent to a free gift, so much of the vast quantity of knowledge which we have accumulated from within the four quarters of this second-rate planet." We are really very much obliged to Mr. Jenkins. We should not have taken credit, perhaps, for extreme old age, but for his kindly suggestion: but we have no objection. Sixteen years have passed since our first book appeared, and it seems to us now that we were very young then: we must have been mistaken, however.—P. W. JACKSON. The difficulty at present is to find space for mechanical engineering.—NEMO. We give a short sketch of Dr. Draper's life, as you request.—AQUARIUS. Twelve years having passed since we rowed in a race, and though sliding seats had then come in, we did not care to give up the old-fashioned fixed seats on which we had learned rowing, so we cannot give any practical explanation as to their working; but, unquestionably, when properly used, they greatly help the rower. We seldom get a chance now of rowing in outrigged boats, the only rowing we much care for.—J. J. D. The difficulty is that while, as you say, the picture in Guillemin's Heavens is manifestly incorrect, a correct picture of the moon's path round the sun seems to differ in no observable respect from the elliptic path assigned to the earth. See chapter on the moon's motions in my treatise on the moon.—ROBERT WALKER. Bezique is not in our line.—NEWTON CROSLAND. I also thought "we had parted for ever." Would insert your letter if it were about one-sixth of its length, but as it is, it is impossible.—J. T. POWELL. Thanks, but we have *twice* ten thousand names of schools, &c., and expect before long to reach them all. We are growing fast, and we "seek not to proticipate." We agree with you that Mr. Grant Allen's papers are charming.—M. A. TURNER. Did not Professor Wilson refer to Mr. Gosse's well-known chapter about immured toads, in his first reply on the subject? It seemed certainly clear to us that he was well acquainted with it, as we suppose most students of natural history must be.—J. WANKLYN. Quite so; these questions of classification are of themselves of no importance whatever. A new rule for classifying introduces no new facts. It is as though one who had been familiar with the arrangement of the bookshelves in a library, and with the contents of the books in them, should be told—when he came back a year or two later, perhaps, to the place, and some changes had been made in the arrangement of books—that he knew nothing about the books because he knew only of their old arrangement on the shelves.—C. A. T. "Five of Clubs" has already corrected the omission.—A. E. S. Brewster spoke of faith in other inhabited worlds as the hope of the philosopher and the faith of the Christian, or the faith of the philosopher and the hope of the Christian. I forget which, exactly. It matters not; the theory is not "based on any religious principles."—R. E. J. You can hardly say that the sails of a windmill go with the sun, or against the sun. If the wind is from the north the eastern arm goes down, and the western arm up. If the wind is from the south the reverse holds.—F. COWLEY. If you will try to picture a star as emitting rays in all directions, which, once emitted, travel continuously outwards, you will see that there is no real difficulty. As to the waves arriving when the star is "below the horizon or anywhere else," you might equally say that sea-waves, leaving England for—let us say America—may arrive there when people in England are in bed or anywhere else.—C. UPHAM. Many thanks for your letter.—SIDNEY JEWBURN. Never mind the gilt edge, or the crest, or the scent; it is not the paper, but what is written on the paper, we care for. Thanks, all the same. As to the toad story, we heard the same story told about *Cimex lectularius*. The ring of light round the moon emphatically can *not* be explained as you suggest. Is not the cat's-eye phenomenon known to most persons? Your plan for testing a cat's power of turning is not cruel to the cat, but might be inconvenient to the experimenter. Cats do turn with wonderful rapidity, but we really cannot advise our readers, in their search for knowledge, to "seize a cat, the two front legs in the left hand, the two hind ones in the right, to hold her upside down, with her back two inches from the floor, let go, and observe how, in the two-inch fall, she will turn round and fall on her feet." Unless, indeed, you could guarantee her quiescence before she was "let go."—NEW ZEALAND. The Wanganui is a splendid river for rowing. A year ago we had a splendid twenty miles spin on the Wanganui in a four-oared clinker-built outrigged boat, and judged it to be better for boat racing even than the Paramatta in New South Wales, on which river also we had some capital rowing. The Paramatta, indeed, is hardly a river, it is an inlet of the sea—at least as far up as the racecourse.—JOHANNISBERG. The *English Mechanic* is—or used to be, when I knew it—an excellent paper, but it does not give the latest method of calculating "the phases of Orion." You must be mistaken. In the first place, no reviewer could be so ignorant as to write such rubbish; but if any could, the sub-editor would know it was nonsense, and certainly would not think of allowing it to be quoted. Of course Orion has no phases, and, therefore, it stands to reason no method—earliest or latest—has ever been invented for calculating them.—M. McC. Phrenology would certainly not be proved by the evidence you mention. But there can be very little doubt that there is a certain correlation between the capacity for music, painting, &c., and the conformation of those parts of the head where phrenologists place the bumps corresponding to these arts. So, readiness of verbal expression is almost always found in full-eyed persons, as Gall noticed at the very beginning of his observations. There is a very strong argument from induction with regard to many of the localisations of phrenology, but they have no more real bearing on cerebral localisation than has the observed fact that blue-eyed white cats (male) are commonly deaf.—J. WHITLEY. We propose soon to have a paper on the approaching transit of Venus. If we put in your query we should have about fifty replies, every one of which, though only one could appear, would involve just as much trouble to us as though we used it. If you could see our parcels of letters (they are no longer forwarded from the head office in envelopes, even the largest sizes failing to hold them), you would understand our reluctance to insert queries. We note that with a power of 200 the apparent diameter of Venus in transit next December will be 1° 54′ 40″. The size of the O.G. and its focal length need not have been mentioned when the power was given.—F. RHYLES. You are right about the beading, but we know from the aspect of the ring when seen edgewise that there is no such inequality there.—WALTER G. WOOLLCOMBE. It does so chance that we had forgotten about Clerk Maxwell's Theory; but it is the merest accident that you should be right, for there are many subjects about which we are ignorant. We thought this was one of them, but, instead of ignorance, must now plead forgetfulness.—J. O. M, Excuse us; but no space for the Cuddapah question. So few readers would be interested, and so many other subjects crowding in upon us.—J. N. BARNES. The paragraph to which you refer appeared only in the first edition of the "Vestiges;" more experienced students of science explained to the author of that work that he had erred.—JOHN ROUSE. We have searched for one of the questions in vain. We remember receiving them, and had intended

to insert both. Probably it was among some which were lost out of a large envelope which burst open during postal transit.—M. H. C., FRED ROLLET, E. LUXMORE, M. B. E., and others. Thanks about the Zoetrope corrections. We propose to discuss shortly the principles of magic wheels, &c.—URSA. Query on Logic should be sent to a paper dealing specially with such subjects; the others inserted.—A. E. S. Daylight *seems* only to change unequally in the morning and evening. If we took true solar noon instead of mean noon, the increase would be found uniform.—CONTINENTAL SHADE. Depends on the eyesight, and no one has yet determined the average eye power for discerning shades.—G. W. NIVEN. How very carefully you make your articles too long for any use. A column of arithmetical curiosities would be pleasant enough, but four pages would be too much.—W. GIBSON. Letter on sun heat crowded out.—A. J. MARTIN. It is absolutely necessary that all "copy" should be in the printers' hands by first post on Monday. The greater part should reach them on Friday. We are far from being able to promise that letters or queries received before Saturday will appear in the next number. To say the truth the correspondence has grown so as to interfere most unduly with the conduct of the paper generally. If our paper were high-priced enough to command the services of six sub-editors (besides chess, whist, and mathematical editors), with a sixteen-page correspondence supplement weekly, we might give due attention to the progress of the more important departments. But it is not. The worst of it is that so many correspondents send us really valuable matter, that we *must* go through the multitudinous heap of matter not valuable, received weekly. If everyone who proposes to write to us were to ask first whether he really has something which he ought to say, or whether a question he is going to ask might not quite readily be answered if he took a little trouble for himself, if, then, having decided to write, he would put his communication in the fewest words, and afterwards strike out all the extraneous matter which the inexperienced pen *will* throw in, it would save us a world of really trying labour. Even then, judging from what reaches us, two out of three communications might well have reached the writer's waste-paper basket as ours. Kindly read again what F.R.A.S., says about wiping the object-glass of your telescope.—H. T. EDMONDS, W. B. RUSSELL, &c. Every one who has studied natural history at all knows that the distinctions you mention exist between the Batrachians and the animals now classed as the only Reptiles. The question how they are classified is one thing, the question why they are so classified is another. To myself, all such questions seem to me not only unimportant, but often mischievous—the student is led to think more of form and phrase than of substance; he is content to learn the long names which have been adopted in classification, and to attend very little to the observed facts of nature. One may begin to suspect a man's zeal for science (as well as his common sense) when he is anxious to display his familiarity with scientific terminology.—MOGUL. Many thanks for rectangles, &c. We had taken your first letter as only private in regard to name.—ONLY A WOMAN. The toad difficulties tolerably obvious. As to the other question, the upper weight would be brought to the ground by the effect of the impulse communicated to it. There being no friction, and the weights being equally balanced, there is nothing to destroy the momentum once imparted until the weight reaches the ground. The worm actually causes the anæmic condition, being a blood-sucker.—URSA MAJOR. Would you kindly put your questions into compact query form? One is suitable for the Mathematical Column, the other for the general queries.—J. O. M. So many magic square communications have reached us that "we know not what to do" with them. Each requires careful study, and would occupy a large amount of space; they interest but a small proportion of our readers. We must now cease to deal with them.—A. HOWARD. No space at present. — J. F. RUSSELL. See answer above about Electro-Magnetic Theory of Light. — O. DAWSON. We must not perplex correspondents by being too particular. — C. G. R. The plan has been thought of; but the trouble is that opportunities for observing are so few, and all the part proprietors of an amateur observatory would want to use it when observing conditions were favourable.—A. T. E. No reply to query 49, page 101, has been received. After all, a quarter of a man's weight (say he weighed 160 lb.) is not much to lift, and the conditions are of course more favourable after a long breath has been drawn, as you find in lifting a dead weight. This, and a lively imagination, will explain the phenomenon, I think.—I. G. O. No longer space for a question not very important in itself.—AN OCTOGENARIAN. Mercury can readily be seen with the naked eye at the time when the "Nautical Almanac" speaks of him as at his greatest elongation, east or west,—before sunrise when the elevation is west, after sunset when it is east, and of course near the sun's place below the horizon.—ACCIDENT. The correction already made.—C. E. H. Your solution correct and neat.—J. RICKARD. Cat story too long for its purport. (Cat troubled with her milk brought a peace offering—fruitlessly—to a before-hated kitten for relief.)—R. W. J. Dog story, ditto; the "fore and aft chaff" between yourself and friend about the bulldog has no scientific bearing. (Bulldog, having passed two men on his way to a gate, which he found locked, went back after them, and persistently bullied them till they opened it.)—CHEVALIER. Game sent to Mephisto.—A. T. C. Seriously, do you want me to say it was a miracle? A distant flight of birds crossing the sun's disc, so that you could have seen them in transit from the nail-holes, but not from the opening just above, would account for what you saw. Or, some other light intercepting passing object, at a suitable distance. If you had looked at once through one of the holes you would doubtless have seen it; looking otherwise you would probably have missed it. All I know (not having been there) is that no miracle probably occurred, and that therefore as a shadow was thrown there was something which threw it. Your solutions of the three-square problem are neat. It would surprise you very much, I take it, to hear that the number of solutions is *infinite*, "if you may cut them as you will."—SIMPLEX. Not knowing Bell's shorthand system, cannot say; can you describe it briefly?—A. Thanks about trotting horse; regret that your question about Induction Coils has remained unanswered.—W. WILSON. It seems to me the ordinary expression "I see the light" is the one which needs correction. Define light, and put the words "I see" before your definition, and see what comes of it.—F. HALLE. Scarcely in our line.—M.A., F.S.A. *Is* there a mathematical demonstration of the divisibility of matter?—F. L. C., or Z. L. C., or F. C. S., or F. C. L. About sunlight on fire and poker across it in our article on "Fallacies."—C. R. T. Seeing Debillissima with a 3½ inch O.G. would, in my opinion, mean good eyesight. It is impossible to infer the qualities of a telescope from such observations. Mr. Sadler counts about a hundred mistakes in the new edition of Smyth's Bedford Catalogue. You do not say what sort of catalogue you mean.—T. R. CLAPHAM. Thanks.—SUBSCRIBER. Your query indistinct. Besides, to "give you all that is known on the subject," would be to give you two or three numbers to yourself.—A. T. WRIGHT. Cannot enter into discussion of various shorthand systems; they are not scientific matters.—J. H. GARFIT. Your article on the giraffe reminds us of his neck; obliged to decline it.

[Here, for the present, we stop. We beg to invite correspondents' attention to the fact that we have been able to go through only about two-thirds of the correspondence which reached us up to Saturday afternoon (Jan. 21), that only about half of those letters, queries, and replies which we should have liked to use can find a place in our columns, and perhaps only about half of that can appear next week. Original matter, notices of books, and paragraphs suited to our columns may make way in some degree, but they must not make way altogether, for correspondence, queries, and replies, for matter in fine, which we insert to oblige correspondents.—ED.]

Notes on Art and Science.

"COLD CATCHING."—It is noteworthy as a curious yet easily explicable fact, that few persons take cold who are not either self-consciously careful, or fearful of the consequences of exposure. If the attention be wholly diverted from the existance of danger, by some supreme concentration of thought, as, for example, when escaping from a house on fire or plunging into cold water to save life—the effects of "chill" are seldom experienced. This alone should serve to suggest that the influence exerted by cold falls on the nervous system. The immediate effects of a displacement of blood from the surface, and its determination to the internal organs, are not, as was once supposed, sufficient to produce the sort of congestion that issues in inflammation. If it were so, an inflammatory condition would be the common characteristic of our bodily state. When the vascular system is healthy, and that part of the nervous apparatus by which the calibre of the vessels is controlled performs its proper functions normally, any disturbance of equilibrium in the circulatory system which may have been produced by external cold will be quickly adjusted. It is, therefore, on the state of the nervous system that everything depends, and it is, as we have said, on the nervous system the stress of a "chill" falls. Consciousness is one element in the production of a cold, and when that is wanting the phenomenon is not very likely to ensue. It is in this way that persons who do not cultivate the fear of cold-catching are not, as a rule, subject to this infliction. This is one reason why the habit of wrapping-up tends to create a morbid sensibility. The mind by its fear-begetting precautions keeps the nervous system on the alert for impressions of cold, and the centres are, so to say, panic-stricken when only a slight sensation occurs.

XUM

Cold applied to the surface, even in the form of a gentle current of air somewhat lower in temperature than the skin, will produce the "feeling" of "chill." Conversely a thought will often give rise to the "feeling" of cold applied to the surface—for example, of "cold water running down the back." Many of the sensations of cold or heat which are experienced by the hypersensitve have no external cause. They are purely ideational in their mode of origination, and ideal in fact.—*Lancet.*

EFFECT OF COMPRESSION ON SOLIDS.—According to the *Revue Scientifique*, Mr. W. Spring, a German chemist, has recently published an interesting memoir, giving the results of a series of experiments undertaken to ascertain the effect of powerful compression on the most diverse bodies. The substances experimented with were taken in the form of fine powder, and submitted, in a steel mould, to pressures varying from 2,000 to 7,000 atmospheres, or about 7,000 kilogrammes per square centimetre. The facts observed are given in a series of tables, from which we extract some of the more curious results. Lead filings, at a pressure of 2,000 atmospheres, were transformed into a solid block, which no longer showed the least grain under the microscope, and the density of which was 11·5, while that of ordinary lead is 11·3 only. At 5,000 atmospheres the lead became like a fluid and ran out through all the interstices of the apparatus. The powders of zinc and bismuth, at 5,000 to 6,000 atmospheres, gave solid block having a *crystalline* fracture. Towards 6,000 atmospheres zinc and tin appeared to liquify. Powder of prismatic sulphur was transformed into a solid block of octahedric sulphur. Soft sulphur and octahedric sulphur led to the same result as prismatic. Red phosphorus appeared also to pass into the denser state of black phosphorus. As may be seen from this, simple bodies undergo chemical transformations by the simple action of pressure. The change of amorphous powders, like that of zinc into crystalline masses, is a sort of self-combination. Certain hard metals do not lose their pulverulent structure at any pressure.

Binoxide of manganese and the sulphides of zinc and lead in powder weld when compressed, and exhibit the appearance, respectively, of natural crystallised pyrolusite, blende, and galena; while silica and the oxides and sulphides of arsenic undergo no agglomeration. A certain number of pulverised salts solidify through pressure, and become transparent, thus proving the union of the molecules. At high pressures the hydrated salts, such as sulphate of soda, can be completely liquefied. Various organic substances, such as fatty acids, damp cotton, and starch, change their appearance, lose their texture, and consequently undergo considerable molecular change.

Our Mathematical Column.

MATHEMATICAL QUERIES.

[20]—I find in "Todhunter's Differential Calculus" the following problem:—What is the greatest equilateral triangle which can be circumscribed about a given triangle? I am not able myself to employ the methods of the "Differential Calculus." Is there any way of solving this problem by geometrical methods?—NO ANALYST.

[Try the following:—On the three sides of the triangle, describe, outside the triangle, segments, each containing an angle of sixty degrees. Then it can readily be seen that if any straight line be drawn through an angle A of the triangle, to meet the two arcs on AB, AC in P and Q respectively, then PB and QC produced will meet on the arc which has been drawn upon BC, and the triangle thus formed will be equilateral. All we have to do then is to determine the greatest straight line which can thus be drawn through A; and it needs very little familiarity with geometrical methods to see that the greatest straight line which can be thus drawn is the straight line parallel to the line joining the centres of the arcs on AB, AC. From this the formula in "Todhunter's Differential Calculus" for the side of the maximum equilateral triangle follows at once.—ED.]

[21]—"Zares" asks us to give the formulas for solving the problem, How fast should the earth rotate that the centrifugal force at the equator should just counterbalance the attractive force of gravity?

The following is the solution of "Zares'" problem:—

Let T be the time in seconds in which the earth should rotate that the force of gravity g should be exactly balanced at the equator by centrifugal force. Let the earth's equatorial radius $= r$. Then the velocity of a point at the equator $= 2\pi r \div T$, and the centrifugal tendency which gravity has to resist is represented by (the vel.)^2 divided by (the radius). So that when the force of gravity is exactly balanced, we have

$$g = \left(\frac{2\pi r}{T}\right)^2 \cdot \frac{1}{r} = \left(\frac{2\pi}{T}\right) r$$

wherefore $T = 2\pi\sqrt{\frac{r}{g}}$.

Taking a second for the unit of time, a foot for the unit of length, and the earth's equatorial radius as 20,925,000 ft. (the equator is not perfectly circular, its greatest and least diameters differing by about two miles), we have, in numbers,

$$T = 6{\cdot}2432\sqrt{\frac{20{,}925{,}000}{32{\cdot}2}}$$

Now, $\frac{1}{2}$ log. 20,925,000 = 3·6603328
$\frac{1}{2}$ log. 32·2 = 0·7539279

Difference = 2·9064049
log. 6·2432 = 0·7954072

Sum = 3·7018121 = log. 5032·83

Therefore, T = 5032·83 seconds
= 83 m. 52·83 s. = 1 hr. 23 m. 52·83 s.

If the earth rotated, then, in this time, or roughly in 1 hr. 24 m., bodies at the equator would be absolutely without weight.—ED.

[22]—EQUATIONS; ASTRONOMICAL PROBLEMS.—Can any of your readers give solutions of the following equations?

$$(\alpha) \qquad \frac{x^2}{a^2}+\frac{y^2}{b}=\frac{a}{x}+\frac{b^2}{y}=a+b$$

$$(\beta) \qquad 2x\sqrt{x^2+a^2}+2x\sqrt{x^2+b}$$

(i.) When is Venus brightest

(ii.) My watch loses 5′ per day. I travel eastward at such a rate that it keeps correct time. In what time shall I complete the circuit?

(iii.) A star's meridional zenith distance and north declination are equal (δ), how long is the star above the horizon?

(iv.) Find the difference between the synodic periods of Jupiter and Saturn with the earth, assuming mean distances as 1 : 5 : 9.—RUEVERTE.

[15]—By a ridiculous oversight, after sending this question (see p. 258) to the printers, we dealt only with one of the equations we had written down. Of course, there are two, viz.: —

$$x\,(y+5)=1000$$
$$y\,(100-x)=1000$$

Or, $x+20\,y=400$, whence $(400-20\,y)\,(y+5)=1000$. The rest is obvious.—ED.

Our Chess Column.

PROBLEM NO. 14.

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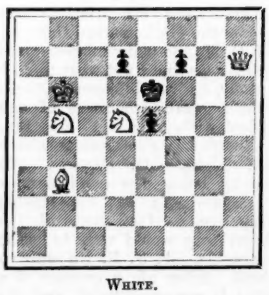

WHITE.

White to play and mate in two moves.

PROBLEM NO. 15.

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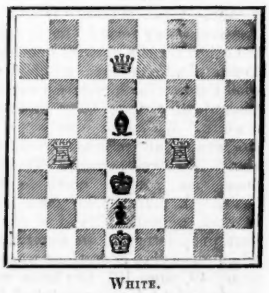


WHITE.

White to play and "self" mate in two moves.

The two-mover is a prize problem from the *Huddersfield College Magazine* Tourney of 1877. A remarkable fact occurred in connection with this problem. The *Huddersfield College Magazine* published this problem in October, 1877, as composed by W. A. Skinkmann. Simultaneously with this, the *Free Press* published exactly the same position as composed by Mr. G. E. Carpenter. It was afterwards ascertained that Mr. Carpenter composed his problem two years prior to Mr. Skinkmann, and it was also admitted that Mr. Skinkmann had no cognisance of Mr. Carpenter's problem. This forms a remarkable coincidence of ideas by two

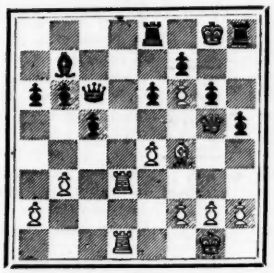
eminent composers. It is now known under the name of the Carpenter-Skinkmann problem. The other is from the *Chess-Players' Chronicle.*

The following pretty ending occurred in a game played in the match of Liverpool *v.* Manchester (H. Jones, Manchester) (Rev. J. Owen, Liverpool). We copy from the *Field.*

Position after Black's 28th move.

Rev. J. Owen.

BLACK.



WHITE.

Mr. H. Jones.

White continued with

29. R. to Q.8.	29. K. to B. sq.
30. Q.R. to Q.7 (a).	30. P. to K.4.
31. Q. to R.6 (ch.) (b).	31. R. takes Q.
32. B. takes R. (ch.)	32. K. to Kt. sq.
33. R. takes R. (ch.)	33. K. to R.2.
34. B. to Kt.7.	34. P. to K.Kt.4.
35. R. to R.8 (ch.)	35. K. to Kt.3.
36. R. to R.6 (mate).	

(a) The winning *coup*, which blocks out the adverse Q., and threatens the decisive B. to Q.6 (ch.).

(b) A highly ingenious master-stroke. Mate in six more moves is forced after this.

Game played at Mephisto's Rooms, 48A, Regent-street, between Mr. W. Cook and Mephisto:—

WHITE. Mr. W. Cook.	BLACK. Mephisto.
Bishop's Gambit.	
1. P. to K.4.	1. P. to K.4.
2. P. to K.B.4.	2. P. takes P.
3. B. to B.4.	3. P. to Q.4.
4. B. takes P.	4. Q. to R.5. (ch.)
5. K. to B.sq.	5. P. to K.Kt.4.
6. P. to Q.4.	6. B. to Kt.2.
7. Kt. to Q.B.3.	7. Kt. to K.2.
8. Kt. to B.3.	8. Q. to R.4.
9. B. to B.4 (a).	9. P. to Kt.5. (b)
10. Kt. to K.sq.	10. P. to B.6.
11. P. to Kt.3.	11. B. to Q.2.
12. B. to K.3.	12. Kt. to Q.B.3.
13. P. to Q.R.3.	13. Castles Q.R.
14. P. to Q.Kt.4 (c).	14. B. to K.3 (d).
15. B. takes B.	15. P. takes B.
16. P. to K.5 (e).	16. Kt. to B.4.
17. B. to B.2.	17. Q.Kt. takes Q.P
18. Kt. to Q.3	18. Q. to R.6. (ch.)
19. K. to K.sq.	19. B. to R. 3.
20. Kt. to K.4.	20. Kt. to K.6.
21. B. takes Kt.	21. B. takes B.
22. Kt. to K.B.4 (f).	22. Q. to Kt.7 (g)
23. Kt. takes Q.	23. P. takes Kt.
24. Kt. to B.2 (h).	24. K.R. to. B.sq. (i).
White resigns (j).	

NOTES BY MEPHISTO.

(a) The new edition of Mr. Cook's synopsis of the openings gives Q.P. to K.R.4, which, in our opinion, is the better move, as then Black could not venture on capturing the Bishop, as it is part of the plan of attack in this opening to get the Queen's Knight to Q.5.

(b) The hasty advance of these Pawns is sometimes inadvisable, as the White King, although apparently exposed, is nevertheless fairly safe. A somewhat similar position of the King runs in the Salvio Gambit. Mr. Steinitz here prefers Kt. to Q.B.3.

(c) This move lost the game. Black's intention of Castling on the Queen's side was obviously to obtain an attack on the White centre, which P. to Kt.4 facilitates, as, on account of the pinning action of Black's Bishop on Kt.2, the White Queen's Pawn and Knight are fixed in a disadvantageous manner.

(d) This move forces the position. The Queen's Pawn cannot be defended.

(e) Played, perhaps, with the intention of exchanging Rook and piece for Queen. He had no good move.

(f) Played with the intention of preventing Q. to Kt.7. If, now, Black plays, B. takes Kt. followed, on Pawn retaking, by Q. to Kt. 7. Then White plays Kt. to B.2. White's position is very bad in any case.

(g) This position is as sound as it is forcible. He threatens Q., takes R. (ch.), and Kt. takes P. (ch.), which compels White to take the Queen.

(h) As good as any other move. If 24. R. to B.2, then

24. R. to B.2, Kt. to B.6 (ch.) 25. K. to K.2, R. takes Q. 26. R. takes R., P. Queens. 27. R. takes Q., B. takes R. with a piece ahead.

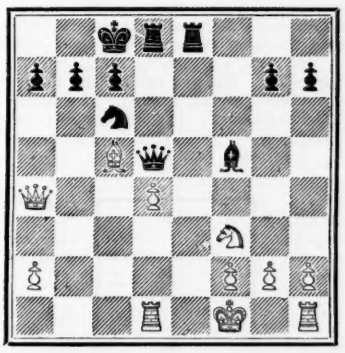
(i) P takes R., followed by Kt. to B.6 (ch.), would also have left Black with a piece more.

(j) To find out the precise mode of winning, whatever White may do, might be interesting to our young readers.

The death is announced of Mr. S. G. Boden, a chess-player of great excellence. The *Field* gives the following brilliant end game as a specimen of fine play on the part of the deceased:—

BLACK.

Mr. Boden.



WHITE.

Rev. G. A. MacDonnell.

It was Black's turn to play on the 20th move, and the game proceeded thus:—

WHITE.	BLACK.
	20. Q. takes Kt.
21. P. takes Q.	21. B. to R.6. (ch.)
22. K. to Kt.sq.	22. R. to K.3.
23. Q. to B.2.	23. R. takes Q.P.
24. B. takes R. Resigned.	24. Kt. takes B.

The sacrifice of the Q. in conjunction with the ultimate giving up of the R. belongs to the finest specimen of chess tactics in actual play.

A. J. MARTIN and J. P.—In Problem 5, if 1. K. to K.3, (1) B. takes P. (ch.), then 2 R. covers, disclosing check, and Black King goes to K.3; there is then no mate. Of course, the first move in our solution should have been K. to K.2., not Q.2. He cannot go to Q.2. How does J. P. make out that if K. goes to K.2, there is no mate in three? In Problem 11 no mate in two.—ED.

VICAR.—Your treatment of Mr. Maas's end game is correct. What seems White's obvious first move leads to defeat. Problems 10 and 11 correctly solved.—ED.

CAROLUS.—Your solution of Problem 11, p. 240, is erroneous. After the two Knights have checked, when Bishop checks as you propose, what is to prevent Black from playing R. takes B.?—ED.

XUM

W. GODDEN.—Your solutions of No. 6 and No. 11 (the former received earlier) are correct.—ED.

G. W. MIDDLETON.—Your solutions of 6, 7, and 8, correct.—ED.

HENRY FITZHART.—If, in the third variation on page 215, move 12, White should play 12. Kt. takes Q.B.P., instead of 12. B. takes Q.P.B. (ch.), then Black would simply reply with 12. Q. takes B., winning a piece.—MEPHISTO.

Problems numbered 11 and 12 in No. 12, should have been numbered respectively 12 and 13.

NOTE.—The Chess Editorship, which has till now been divided between Mephisto and the General Editor, will henceforth be left to the former. Letters belonging to this department should be directed Chess Editor of KNOWLEDGE, 74, Great Queen-street.

Our Whist Column.

BY "FIVE OF CLUBS."

AN OMISSION FROM OUR LEADS IN PLAIN SUITS.

WE omitted to note among our leads four, one lead of Knave, two of Ten, and one of Nine. Besides the two cases noted, Knave is led from King, Queen, Knave, with or without others; and besides the cases noted, Ten is led from King, Queen, Knave, Ten, with or without others. The object is, in either case, to get the Ace, even though held by partner, out of the way, after which the entire command is retained in the suit. Again, Ten is led from King, Knave, Ten, with or without others. Lastly, Nine is led from King, Knave, Ten, Nine, with or without others.

We give this week a game which, as it happens, illustrates the lead of Knave just mentioned. It is intended, however, to illustrate what we said in our last about playing a waiting game in trumps. It may be mentioned as rather amusing, that in the actual game, one of the players, forgetting the strict rule of whist, remarked, when the second round of trumps was played without the Ace falling, "Well, some one must be an unmitigated —" (the rest was left unexpressed). He was one of the losers, and slightly changed his tone about the tenth round. It is hardly necessary to say, however, that he should have been silent all the time, whatever his opinion of the play.

THE HANDS.

A.
Hearts—K, Q, 7.
Spades—K, Q, Kn, 9, 7, 3.
Diamonds—A, Q.
Clubs—6, 4.

B.
Hearts—Kn, 9, 3.
Spades—A, 10.
Diamonds—K Kn, 9, 5, 4, 2
Clubs—7, 5.

Y.
Hearts—8, 6, 2.
Spades—8, 6, 5.
Diamonds—10, 8, 3.
Clubs—Kn, 10, 9, 3.

Z.
Hearts—A, 10, 5, 4.
Spades—4, 2.
Diamonds—7, 6.
Clubs—A, K, Q, 8, 2.

Score:—A B = 4; Y Z = 4.

NOTE.—The underlined card wins trick, and card below it leads next.

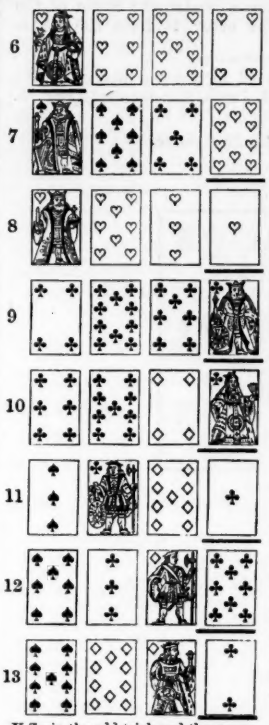
	A	*Y*	*B*	*Z*
1	♠A	♠8	♠Kn	♠3
2	♠K	♢8	♢10	♢9
3	♢A	♢Q	♢K	♢7
4	♠Q	♠6	♠9	♠10
5	♡7	♡2	♡Kn	♡5

REMARKS AND INFERENCES.

1.—*A* may have led from Knave, ten, nine, so far as Y or Z can tell. *B*, holding the ten, knows the lead is from King, Queen, Knave. He puts on Ace to give his partner command of the suit. If he played Ten, *A* would continue with Queen, and Ace would take it, whereas by playing ten, on returning the suit, *B* leaves his partner the option of taking the trick, or letting the Ten take it. As the cards lie, *B* does not get the chance of returning his partner's lead, after showing his own strong suit.

2.—*B* leads the ante-penultimate, Drayson's plan for showing six of a suit.

3.—Seeing that Four of Diamonds cannot lie with *Y* or *Z* (from their play), *A* should place it with *B*, and credit *B* with all the remaining diamonds but one.



Y-Z win the odd trick and the game.

4.—*A* has all the remaining spades but one, which may lie either with *Y* or *Z*.

5.—*A* does not continue his established suit, fearing to force his partner *Y* trumping first. But he had two chances in his favour if he had led them. First, he would as probably be forcing an adverse strong trump hand, as one held by *B*; secondly, *Z* may have the remaining spade, in which case *B* would lie over *Y* in ruffing, and still only trump for trump be drawn. *A*'s fault here loses the game, though it requires keen play by *Y* and *Z* to win it with such a wretched hand as *Y* has. *Z* does not win the trick, knowing that his only chance lies in taking the last round of trumps. He plays Five (Four being the trump card), to show his partner one more card.

6.—*B* leads the highest of two cards left; the fall of the cards shows *A* that *B* must have the Three, and therefore no other, and *A* should tremble. Yet with such cards as he knows to remain in his hands and *B*'s, with reasonable probability that at least one good club lies with *B*, *A* does not yet despair. He knows, however, that Ace must lie with the enemy, and the way it is kept back is ominous of trouble.

7.—*A* resumes his long suit when the mischief is done. If he had drawn a trump from *Z*, he might himself, holding King and Queen, have played the waiting game. *Z* trumps, disregarding the probability that *A* held originally four trumps,—for this simple reason, that, as the score stands, *Y* and *Z* must make every other trick.

8.—*A* should tremble still more; yet even now a single trick will save and win *A-B*'s game, and nothing but very careful play can win *Y-Z*'s.

9.—*Y*'s play of the Club Ten is excellent. He knows that *Z* will place the Knave in *Y*'s hand so soon as another round has fallen, if not at once, so that if *Z* has only Ace and King at the head of his club suit, and draws the Queen from the enemy, second round, *Z* will still credit *Y* with the power of making another trick in Clubs and returning a small one; while if *Z* has Ace, King, and Queen at the head of his Club suit, *Y* will be able to throw away the remaining high cards. If at this stage *Y* had played the Three, *Y-Z* would have lost the odd trick and the game. As the cards lie, he can do no harm by leading either Knave or Nine. Even if *A* has not the Queen, and it falls at the second round, *A*'s knowing that *Y* has the Knave may not be essential to *Y-Z*'s success*; but it is good whist to give the information, all the same. Observe: the Knave could not possibly be played by a good whist player; the nine would be the usual play; but by playing the Ten, *Y* shows his partner the position of the only card to be dreaded, if *Z*, having Ace and King, can draw the Queen. *A* having Ace, King, Queen, the Knave is not wanted, and *Y* throws it away, leaving *Z* to make both Eight and Two.

* Put Queen of Clubs in *A*'s hand, and Six of Clubs in *Z*'s, then *Y-Z* would equally win the game, thus:—

	Z	*A*	*Y*	*B*		*Z*	*A*	*Y*	*B*
10.	C A	C Q	C 9	D 4	12.	C 8	S 7	C 3	D Kn
11.	C 2	S 3	C Kn	D 9	13.	C 6	S 9	D 10	D K

NOTICES.

The Publishers beg to announce that in future Monthly Parts of KNOWLEDGE will be issued. The following can now be had:—

PART I.—(November, 1881.) Containing the first four numbers. Price 10d. Post-free, 1s.

PART II.—(December, 1881.) Containing five numbers. Price 1s. Post-free, 1s. 2d.

PART III.—(January, 1882.) Containing four numbers. Price 10d. Post-free, 1s.

The Back Numbers of KNOWLEDGE, with the exception of No. 2 (Nov. 11, 1881), and No. 3 (Nov. 18, 1881), are in print, and can be obtained from all booksellers and newsagents, or direct from the Publishers. Should any difficulty arise in obtaining the paper, an application to the Publishers is respectfully requested.

Subscribers wishing to complete their sets are advised to make early application to the Publishers, as no further reprints will be ordered.